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DIFFERENCE DISCRIMINATION AND THE CONDITIONED REACTION

BY

LEON GINSBERG

Submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, in the Faculty of Philosophy, Columbia University

NEW YORK

MAY, 1924

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DIFFERENCE DISCRIMINATION *and the* CONDITIONED REACTION

I. INTRODUCTION

Warner Brown,[1] experimenting with lifted weights, came to these conclusions:

> In the case of lifted weights, it is found that every difference, no matter how great or how small, yields both right and wrong answers. No warrant is found for designating any particular amount of difference as the threshold.
>
> Experimenting with differences which are very small, it is found that the number of right answers always increases with an increase in the amount of difference. No subliminal difference is found. No threshold or just noticeable difference can be found.

Pavlov,[2] and the Russian School of which he is the leader, using dogs as subjects and the Conditioned Reflex Method as an experimental method, found that dogs give evidence of very fine discrimination.

> By stimulating the gland with food at strictly regular intervals, a specific salivary reaction may be formed on a time basis. It will be found that the 29th period will be definitely distinguished from the 31st in a 30 minute period. (Theogritova, U.P.)
>
> Separate sounds are received by the auditory apparatus of the dog as distinct stimuli even when they differ from one another by only a quarter of a tone.
>
> Even comparatively slight changes in the "quality" of familiar sounds result in a diminution and disappearance of the fundamental salivary reaction. (Selionyi.)

Watson found that the Conditioned Reflex Method was applicable to use on human subjects, and he was able to show, by means of this method, that humans evidenced ability to differentiate between two tones differing by three vibrations (not so fine a discriminatory ability as that of Warner Brown's experiment). We have, then, evidence from Warner Brown, Pavlov and his school, and Watson of fine discriminatory ability both of dogs and of humans. The following

[1] Warner Brown, The Judgment of Difference with Special Reference to the Doctrine of the Threshold, in the Case of Lifted Weights. U. of Cal. Pub. in Psy., Vol. I., pp. 1-71, Sept. 24, 1910.

[2] Yerkes & Morgulis, Psy., Bull., 1909, 6. Morgulis, J. Animal Behav., 1914, 4, p. 363.

experiment was undertaken to see if humans show evidence by the conditioned reflex method of discrimination fine enough to differentiate between two sounds that differ in intensity by as small an amount as the difference between the sounds 40 and 39 of the Seashore Audiometer. By the Direct Method it was found that 40 and 39 might perhaps be considered as differing in intensity by an amount comparable to the amount of difference of Warner Brown's two weights 100gs. and 100.1gs. That is to say, just as Brown obtained by the Direct Method a result of 53% correct judgments for the weights 100gs. and 100.1gs., so too, a result of 53-55% or an average of 54% correct judgments was obtained by the Direct Method from all subjects when asked to differentiate between the sounds called 40 and 39 on the Audiometer.

II. HISTORY

The conditioned Reflex method of Pavlov and his school is too familiar to need either an extended introduction or description. It consists essentially in the substitution, through association, of an indifferent stimulus for a natural stimulus in the production of a reflex action. The Pavlov school has used, primarily, the salivary reflex, for the reaction, food as the natural stimulus and the ringing of a bell as the different or secondary stimulus.

Thus, to quote from Morgulis:[1] "if a definite sound is produced while the mouth cavity is irritated with acid and this combination is repeated several times in succession, it will sooner or later happen that the sound will call forth the same reaction which was produced by the acid."

By the repeated combination of any external factor (such as sound, light, odor, etc.) and the physiological stimulus to a glandular or reflex muscular reaction, a temporary association with the definite physiological or reflext cavity is formed, so that, after a time, that external factor which previously had no power to call forth the reaction, now becomes the stimulus for that reaction.

The following is offered as an example of a conditioned reflex experiment:

Selionyi's Study of Auditory Reactions of the Dog.[2]

The purpose of his work was to determine by means of the conditioned reflex method how great must be the difference in the quality or the intensity of two auditory stimuli in order that they shall produce perceivably different effects upon the auditory apparatus of the dog.

Results.

Familiar sound—tuning pipe.

Unfamiliar sound—'rattling whistle.'

Time	Sound	Duration of Stimulus	Quantity of Saliva in Drops
4.25	Unfamiliar	1′ 40″	0
4.55	Familiar	30″	15
5.05	Familiar	20″	5
5.19	Unfamiliar	2′ 15″	0
5.29	Familiar	30″	9

[1] (Morgulis, J. Animal Behav., 1914, 4, p. 363.)

[2] Yerkes & Morgulis, Psy. Bull., 1909, 6, p. 263 ff.

A summary of the results is given in "laws" below.

Some so-called Laws of Conditioned Reflex.[1]

The three most important mentioned by Yerkes and Morgulis are as follows:

Law 1.

A conditioned reflex can be worn out or destroyed by repetition of its conditioning stimulus or stimulus complex. Whereas at first a particular sound, sight or odor which is indicative of food causes the secretion of several drops of saliva, after a few repetitions at short intervals and without the presentation of food it causes no secretion.

This wearing out of the conditioned reflex serves to distinguish it from the unconditioned reflex.

Law 2.

The destruction of a conditioned reflex by repetition does not influence other conditioned reflexes. For example, the wearing out of the conditioned reflex to the sight of a particular kind of food leaves unmodified the reflex to the odor of the food.

Law 3.

Irrelvant stimuli (a sudden noise, a new object in the environment, etc.) produce a depressing effect upon conditioned reflexes. In regard to the nature of their influence, they may conveniently be classed in two groups:

1. Those that temporarily diminish or even suspend the activity of the conditioned reflex, but lose this retarding effect after a few repetitions.

2. Those which at first tend to reduce the intensity of the reflex and finally inhibit it entirely.

Selionyi[2] in his study on the dog, obtained the following results:

1. Separate sounds are received by the auditory apparatus of the dog as distinct stimuli even when they differ from one another by only a quarter of a tone.

2. Sounds which differ from one another only very slightly in quality are received as distinct stimuli.

3. A conditioned reflex of definite intensity is specific (results from) a sound of a given pitch which has become its stimulus.

[1] Psy. Bull., 1909, 6, p. 269.

[2] Selionyi, opus cit.

4. Unfamiliar sounds which differ from the familiar sounds by a slight variation in pitch produce in some dogs additional reflexes which are much less intense than the reflexes to the familiar sounds.

5. Even comparatively slight changes in the quality of "familiar" sounds result in a diminition and disappearance of the fundamental salivory reflex.

6. Sounds which differ from one another very little, in pitch (the quality and intensity remaining constant) may become the stimuli for the secretion of saliva of different degrees of viscidity. Some cause the flow of liquid saliva others of viscid saliva.

7. The specificity of conditioned reflexes for the sounds which induce them may persist for two months.

Watson's Method.

Watson[1] advocated the use of the conditioned reflex as a method for determining differential sensitivity. He substituted, however, the finger reflex for the salivory reaction and faradic stimulation as the primary stimulus. His method is as follows:

He says that it is a comparatively easy task to condition a subject to react to a definite stimulus, A. If, during the course of the experiment, after the subject has been thoroughly conditioned to A, a new stimulus, B differing from A to an extent large enough for the subject to recognize it as different from A, is suddenly introduced, what happens? The subject, whenever B alone is presented, reacts to it for some time as he did to the stimulus A whenever the latter was presented alone.

Can the subject be trained to continue his reaction to A, to which he had previously been conditioned, and to lose his tendency to react to B, to which he had not been conditioned? Watson's answer is in the affirmative. The procedure is as follows:

Present A always immediately followed by shock (punishment). Present the pair about fifty times. Then suddenly present the stimulus A without the shock. If the subject reacts to A alone, as he did to A plus shock we say that he is conditioned to A. Continue the presentation of A plus shock and then suddenly A without the shock about 200 times. About 98% of the time the subject will react to A without shock as he did to A plus shock. The subject is now thoroughly conditioned.

[1] Watson—Psy. From Standpoint of Behaviorist, p. 32.

At this point, without warning, present B without shock instead of A without shock. The subject will in all probability react to B without shock as he did to A without shock. Now present B without shock three or four times, in succession until the subject loses all tendency to react to it. Now give A without shock and we will find that he has lost his tendency to react to A also. At this point begin once more to give A plus shock a number of times and then suddenly A alone. The subject will have regained his reaction impulse to A. If B is now once more introduced, he may once more react to it as to A. If he does repeat B alone a number of times until he is more fatigued to it. Now give A plus shock again. In other words by punishment with A and by both lack of punishment with and a fatiguing repetition of B the subject will gradually begin to react to A whenever it is offered alone and never to B when presented alone.

III. APPARATUS AND PROCEDURE.

Two rooms were used for the experiment. The subject sat in a dark room, the walls, ceiling, floor and doors of which were painted a dull black. The room was 24 by 14 by 14 feet. It was more sound proof than any other room available, but since it communicated with an outer room which gave upon the street, it was not so sound proof as could be desired. Before the subject, upon a table, was the negative electrode, the reacting key, serving also as the positive electrode, and the telephone receiver to be strapped to his head. The subject sat on a swivel chair which could be raised or lowered to a height best suited to enable the S to put his hand and finger on the electrodes without getting arm or shoulder cramp.

In the adjoining room sat the experimenter. Before him, on a large table, was an Audiometer, a Bergstrom-like chronoscope, an induction coil, and the knife switches controlling them. Beside the experimenter, on the floor, stood a rheostat, and a bank of five lamps. The current was tapped from a wall bracket above the E's head.

Production of the Stimuli.

A. Sound.

The sound was produced by a Seashore Audiometer. It was received by the subject through a telephone receiver strapped to his head. The sound produced by the receiver was a click of a certain definite intensity. The intensity could be varied between the limits of a distictly perceptible sound (called 40 on the Audiometer scale) and an imperceptible sound (called 1 on the Audiometer).

B. Shock.

An induction coil was used. By means of the rheostat and the lamp bank, the 120 volts of the house current was reduced to 4 volts at the primary coil of the induction coil. Much difficulty was experienced with the induction coil interrupter, since it often refused to start, or stuck to the contact, or after a day or two of use, a hole was burned in it. It was found more expedient to remove the interrupter and to put into the circuit of the primary coil an ordinary bell buzzer. This never failed to start, did not stick, and did not burn out. The bell itself was removed, and the magnets and buzzer placed in another room in a sound proof box. It worked satisfactorily throughout the experiment.

The Electrodes.

The indifferent, or negative electrode, consisted of a piece of sheet metal about ten by ten inches, mounted on a slab of wood about twenty by twelve inches. The subject placed upon it the palm and the fingers (with the exception of the index finger) of the right hand (if he was right handed). An ordinary telegraph key was used both as the reacting key and as the positive electrode, by putting it in circuit both with the chronoscope and the induction coil, and by replacing the non-conducting button with a metal one.

Procedure.

The Presentation of the Stimuli.

The question rises at once:—are the two stimuli, shock and sound, to be given simultaneously, shall the sound come before the shock, or shall the sound follow the shock? All evidence seems to agree that there will be no backward association between shock and sound, i. e., if the sound follows the shock, it is fairly certain that even after an extended training the presentation of sound alone will not cause the same reaction as was obtained from shock plus sound. The Russian school made it a practice to present both stimuli simultaneously. Both could be perceived,—the food, (the primary stimulus), and the bell as the secondary stimulus. But this procedure was not deemed the best for this experiment. The shock, which was quite strong, was of a nature to obscure the perception of the comparatively faint and indifferent sound obtained from the Audiometer, if both should be presented at the same time. It must be noticed, too, that the sound presented with the shock was quite different (so it appeared to the subject) from the sound presented alone. If the subject, then, is to be trained to react to the sound alone as he had been reacting to sound plus shock, care must be taken to make it appear to the subject as nearly as possible alike in both instances. In other words, the sound must be perceived in its entirety as a definite sound of a fixed intensity and quality whether offered with shock or alone. It was therefore decided to offer the sound before the shock.

To do this, the experimenter's switch had to be a double knife switch. One knife sent the current into the magnets releasing the chronoscope pendulum, and at the same time activating the induction coil, shocked the subject's finger. The same knife of the switch, as soon as the subject released the reaction key, sent current into the magnets controlling the chronoscope pointer, and recorded both the fact that the subject had reacted and the time. The other knife of

the switch controlled the Audiometer. Since the telephone receiver on the subject's ear is inervated both by the make and the break of the current from the Audiometer, some device had to be thought of by means of which both the downward push of the switch against the contact would, by its make, produce a sound in the telephone receiver, whilst the upward pull away from the contact would, by its break, produce a sound in the telephone receiver. The downward push of the switch caused, through one knife, the make for the Audiometer, and the other knife, at the same time, completed the circuits for the induction coil and the chronoscope. Through the upward pull of the switch, the appropriate knife broke the Audiometer current and produced a click in the telephone receiver, while, at the same time, the other knife came in contact with a piece of metal placed about an inch and a half above the base of the switch and in such a manner connected, that it, too, caused the circuits to the induction coil and the chronoscope to be completed. In this way, both an upward and a downward movement of the double knife switch produce the same effect, i. e., activated the audiometer, the induction coil and the chronoscope. Now since the Audiometer click was to be received about 50 sigma before the shock, the knife completing the circuits to the chronoscope and the induction coil must make its contact about 50 sigma later than knife completing the Audiometer circuit. To effect this, a copper, coiled spring about ¾ of an inch in height was made the contact point for the knife controlling the Audiometer. Thus, as the switch was depressed, the Audiometer knife made its contact with the spring, and it was necessary to depress the spring to enable the other knife of the switch to make its contact and activate the induction coil and the chronoscope. The next sound from the Audiometer was produced by breaking the contact between the knife edge and the spring by the upward pull of the switch, and this upward pull continued another inch after leaving the spring, until the appropriate knife made its contact with the price of metal above mentioned and so activated the induction coil and the chronoscope. Thus, whether the switch was depressed or pushed upward, in each case the sound came about 50 sigma before the shock. By means of another switch the circuit to the induction coil could be broken, and the sound alone, without the shock, could be sent to the subject.

In testing the subjects' ability to differentiate between the sounds 40 and 39 by the Direct Method of Warner Brown, the following

procedure was adopted. Each subject was given 100 trials before and after the experiment in which he was used. He was seated before the reaction key in the dark room. The experimenter sat in his room. The knife switch was closed and the current was sent from the Audiometer to the telephone receiver strapped to the subject's head, producing a click. 100 sounds of intensity 40 and 100 sounds of intensity 39 were sent in chance order to the subject. The clicks were sent to the subject at intervals of about six seconds (the average time between the stimuli of the experiment proper). The subject was to judge them in pairs, the second as more intense or less intense than the first. If the second was louder than the first, the reaction key was to be raised twice, thus making two distinct sounds in the chronoscope before the experimenter. If the second click was deemed to be less intense than the first, the reaction key was to be raised once. The experimenter kept a record of correct and incorrect responses, and found the range for all subjects to be from 53 to 55% and an average for all subjects of 54%. Not enough subjects were tested to obtain any percentages below 50.

It was found, too, that none did any better when tested after they had been used as subjects than before. The average of 54% might, then, easily be considered nothing but a chance result.

IV. PRELIMINARY EXPERIMENT

Object:

1. To get some data bearing upon the following questions:—
   A. Whether the conditioned reaction is any different from the reactions in an ordinary reaction time experiment with a ready signal, as to
      1. Automaticity of response.
      2. Clearness of perception of the stimuli.
   B. The influence of the attitude of the subject upon the number of correct responses made by him to secondary stimuli (a correct response is a response made to the secondary stimulus whenever offered alone,—in this experiment sound without shock).
      1. When he is through the experimenter's instructions put into a mental set to respond to the secondary stimulus.
      2. When he is, through the experimenter's instructions put into a mental set not to react to the secondary stimulus.
   C. Is the subject aware of the mental set?
   D. What, from these results are the best instructions to give to the subject?

Subjects:

M. A. and G. M., graduate students in psychology. Both accustomed to reaction time experiments. Neither had more than a superficial knowledge of conditioned reflex experiments.

Procedure:

Series 1.

Subject M. A. seated on a swivel chair. Telephone receiver strapped to his head. Index finger put on the reaction key which subject then depressed. The palm of the same hand put on the indifferent electrode. Two hundred opportunities to react were offered, of which 34 were to sound without shock. The shock was readily perceptible, but not disturbing. Sound intensity 40 on the Audiometer used.

Instructions:

None given him.

Results:

Series 1.

Number of correct response in percentage is 80 ± 3.7. (Percentage obtained as follows,—number of secondary stimuli in a column of reactions on the experimenter's record sheet divided into the number of secondary stimuli reacted to.)

Series 2.

Same procedure and the same subject. No instructions were given him. But this remark was made by the experimenter,—You certainly are suggestible. The last series I fooled you almost every time. I wonder how you'll be today?

Results:

Percentage of correct response is 48±5.75.

The P. E. of the difference between the two series is 6.8 with an actual difference in averages of 32, or a difference in P. E. units of 4.5.

Subject G. M.

Procedure:

Same as above.

Instructions:

Series 1.

None given. Remark made by the experimenter. Subject asked the experimenter: What are you going to do with me? Experimenter's reply: Oh, I'm just curious to see how easily you can be fooled.

Results:

Percentage of correct response to secondary stimuli was 39±6.38.

Series 2.

Same procedure and the same subject. No instructions were given him. This remark made by the experimenter:—the other time you inhibited your reactions by thinking yourself a fool whenever you reacted to sound without shock. Pay no attention this time to your reaction,—don't think of it—just sit back and let your finger react or not as it wishes, don't put your own will into this at all.

Results:

Percentage of response to secondary stimuli was 86.87±2.98.

The P. E. of the difference for the two series was 7 with an actual difference in averages of 47.75 or a difference in P. E. units of 6.8.

Since for both subjects the conditions in both series were the same as to the number of stimuli, the number of secondary stimuli etc. with the exception of the one variant: the remark made to the subject before each series, it would seem that the difference between the series was caused by the attitude or mental set produced in the subject by the experimenter's remark.

Introspections offered by each subject after each series were as follows:—

Subject—M. A.

Series 1

Remark to subject by the experimenter—none.

Result—per cent of response to secondary stimuli —80±3.77.

Introspections

Experimenter's question: why did you react to the sound without the shock? Ans. I don't know. Never watched my finger—paid no attention to it—let it do as it pleased. I didn't know I had reacted until after the reaction,—finger jumped off before I could think of it. Sometimes I didn't know I had heard the sound until after my finger had jumped off the key and drew my attention to the fact that I must have heard the sound. Don't know why I failed to react sometimes. My finger just remained on the key. I think I heard the sound most of the time. Paid no attention to anything,—almost fell asleep in spite of the shock.

Series 2

Remark to subject: You certainly are suggestible. The other time I fooled you. I wonder how you'll be today.

The record of both series 1 and 2 shown to the subject. Then questioned: why didn't you do as well in the second series as in the first? Ans. I don't know. I didn't feel any different,—paid no attention to my finger,—it just wouldn't jump off, I suppose. If it did, it was off before I could think of it. Almost sure I heard the sound all the time.

Subject—G. M.

Series 1

Remark by experimenter to subject: Subject asked—what are you going to do with me? Experimenter replied: Oh, I'm just curious to know how easily you can be fooled.

Result:

Per cent of correct response to secondary stimuli was 39±6.38.

Introspections

Didn't try to influence my finger in any way,—sure I heard the sound each time. I let my finger stay on or jump off as it wished,—it made me smile when I did react to sound when it came without shock,—said to myself: he fooled me that time,—but I made no effort to prevent myself being fooled the next time—let my finger do as it wished.

Series 2

Remark by experimenter to subject: The other time you inhibited your reactions by thinking of yourself as being fooled—pay no attention this time to your reactions—just let your finger react or not, as it wishes, don't put your own will into this at all.

Didn't know I was doing better this time—half the time I didn't know I had reacted until after I had done so and found myself putting my finger back on the key—sometimes I didn't know the sound had come until I found my finger off the key, then I knew I must have heard it without being aware of it.

Result:

Per cent of correct response to secondary stimuli was 86.87±2.98.

An attempt may now be made to answer the questions put at the head of this section:—

Is the conditioned reaction any different from the ordinary reactions in an experiment with ready signal as to:—

a. Automaticity of reaction.

From the experimenter's own experience in both conditioned reaction experiments and in the ordinary reaction time experiment, and from the introspections of the above subjects, it would seem that there is not much difference between the reactions in both types of experiment as to automaticity of response. In the ordinary reaction time experiment the many repetitions of the same stimulus, followed by the same response, and the unchanging mental set brought about by instructions and the ready signal soon bring about an attitude making for automaticity. So very automatic is the response that very often the subject reacts without knowledge of having done so. In conditioned reaction experiments the frequent repetition of combined primary and secondary always followed by the same reaction brings about a state of automaticity in which there is a minimum of attention. Here, too, as in the usual reaction time experiment reactions take place without the knowledge of the subject. Thus, when the secondary stimulus is presented suddenly alone without the company of the primary stimulus, the subject reacts to this part of the entire situation (i. e. he reacts to A as he had been reacting to A plus B).

b. Just as in the reaction time experiment the subject often reacts to the stimulus without being aware that the stimulus had been offered to him, so too, in the conditioned reaction experiment reaction is made before any clear perception of the stimulus is possible.

What then is the difference between the conditioned reaction and the reaction of the reaction time experiment? The difference lies in the instructions given the subject in the reaction time experiment. If, thru the automaticity of response and the minimum of attention required the subject in the reaction time experiment begins to slow down a bit or even occasionally fail to react in spite of the ready signal, he soon comes to with a start,—and having been instructed to react at each appearance of the stimulus, he begins once more to react. In the conditioned reaction experiment, however, when, for some reason the tendency to react to the secondary stimulus begins to break down, the subject, not having been instructed to react to the secondary stimulus and there being no accompaniment with it of punishment, simply stops reacting. At this point punishment must be applied, to serve, it might be said, as a warning or an instruction to react once more.

There is one other difference between the conditioned reaction and the reaction of the reaction time experiment which serves to distinguish the two most clearly. That difference lies in the factor of wearing out, which is of such great importance in all conditioned reaction experiments, and of relatively little importance in all reaction time experiments. In the latter failure to react through lack of attention or what not is quickly remedied and the subject resumes the automatic response once more. In the conditioned reaction experiment, however, there is little or no resumption of reaction after the tendency to react has been lost. And this, very often, in spite of repeated application of the primary stimulus which should act as a further training factor, and which should induce in the subject the same mental set as that induced by the direct command to react of the reaction time experiment.

To the question:—what is the influence of the attitude of the subject upon the number of correct responses?—it can be said that though the results are not conclusive, they yet evidence a tendency on the part of the subject to be so influenced by the remarks of the experimenter before the experiment has begun, that it seems the experimenter may cause the subject to react or fail to react according to his remarks, which are, in reality, veiled instructions. From the

introspections of the subjects it seems they are not necessarily aware that they are in any way controlling their responses, that they are unaware that there is being induced in them a mental set favorable or unfavorable to response to the secondary stimuli.

d. It would seem, then, that since suggestion is a potent factor in determining the reactions of the subjects in the conditioned reaction experiment, it were best to say nothing more in instructing them than how to sit and how to place their hand and finger on the electrodes.

V. EXPERIMENT 1.

Object:

Through the use of Watson's method to attempt to train a subject to differentiate between two stimuli whose intensity difference is 'subliminal'. The two sounds used are called 40 and 39 on the Audiometer employed. Sound 39 is less intense than 40.

Subjects:

All graduate students. Two of the three used were doing graduate work in psychology. The other was a graduate student in electrical engineering. The psychology students had but a superficial knowledge of conditioned reflex experiments, the engineering student was without knowledge of psychological experimentation.

Instructions:

Nothing more was told any subject than how to place his hand and index finger on the electrodes. Then a shock was sent through the finger. He reacted. If he replaced his finger on the key no further instructions were given him. If he failed to replace his finger he was told that after every reaction he was to replace his finger.

The experimenter's record sheet was divided into 40 columns of twenty reactions each. Eight hundred opportunities to react were given. One hundred ninety-two of these were to stimulus without shock.

Subject J. W. was given 14 columns of 20 reactions each to sound plus shock and sound alone. Only sound 40 was used. At column 15 the new stimulus 39 was introduced without shock in place of 40 without shock. Subject reacted to it as he reacted to 40. To fatigue the tendency 39 was repeated 5 times without shock. Subject reacted to it each time. Now shock plus 40 was given number of times. Then once more 39 without shock was given and repeated. Then once more shock plus 40 was given a number of times. Then again 39 was introduced and repeated. In column 19 the subject began to falter and fail to react to 39. It was now thought that subject was beginning to lose his tendency to react to 39 without shock, but it was not known whether he would at this time react to 40 without shock, Shock plus 40 was therefore once more given a number of times and then 40 alone. Subject reacted to it. It was

thought then that the subject had learned to continue his reaction to 40 and had lost his tendency to react to 39. In other words it was thought that the subject had been trained to discriminate between 40 and 39.

Now again a series of 40 plus shock was given and then 39 was once more given alone. Subject failed to react to it. The procedure was twice more repeated and at each presentation of 39 without shock subject failed to react. Then after another series of shock plus 40, 40 instead of 39, was now presented alone. But the subject failed to react to it as he had failed to react to 39. It was found from then on in spite of repeated punishment with 40 and repeated effort to fatigue the tendency to react to 39, that the subject had lost almost all tendency to react to the stimulus when presented without shock. Whenever he did react it was indiscriminately to 40 or to 39.

What was the cause of this failure to react? Since 39 had never been accompanied by punishment and since all tendency to react to it was discouraged by repeated repetition it was expected that the tendency to react to it would be lost. But 40 had always been accompanied by punishment except a few times when presented alone, and furthermore 40 had not been repeated to fatigue the tendency to react to it. Why, then, had this tendency to react to 40 present at the beginning of the experiment been lost? Was it the introduction of the 39 or would the same thing have occurred if 40 had been retained throughout?

The same experiment on the same subject was repeated a few days later but sound 40 was retained thruout. Altho the tendency to react became fatigued as it did in the first experiment yet the wearing out process was not nearly so complete. In fact the subject was reacting almost as well in columns 38, 39, and 40 as he did in columns 13, 14, and 15 when the effort to discourage the reaction tendency was begun.

It was thought that since subject had already had one training series of 800 reactions of the first series he was now so thoroughly conditioned that he did not for that reason so easily fatigue. The same experiment but with the two series now reversed was done with the next subject. This subject manifested the same loss in reaction tendency to sound without shock at the introduction of the sound 39 as had the first. It was felt then that the order in which the experi-

ment had been carried out was not the cause of the difference in the results obtained in the two series of each subject.

With the third subject the order was again reversed, the 40-39 series being given first and on a later day the 40-40 series. The results were the same as those obtained from the first two subjects.

Interpretations of Results:

Since both series of the experiment were alike in the number of shock plus sound stimuli, in the order of presentation of stimuli, in the strength of the current used for punishment, in the intensity of the sound stimulus 40, in fact, as far as possible, exactly alike in everything with the exception of the one variant,—the substitution at a certain point in the one series of the sound 39, for 40, it can be said with little hesitancy that any change in the number of correct responses in that series containing both 39 and 40 is in all probability due to the partial substitution of 39 for 40 in that series. In other words, any interpretation of results must be primarily by means of a comparison between the two series. This comparison is best made by a reference to the graphs, 1, 2, 3 or the composite 4.

Perhaps the better way to make the comparison would be to divide each graph into two parts. Columns 1 to 14 inclusive may be spoken of as the training period, during which the effort was made to train the subject to respond to 40 alone as he was forced to react to 40 plus shock. Columns 15 to 40 may be considered that critical period in which an effort was made to:

1st. Fatigue the tendency displayed by the subject to react to 40 alone. (in the 40 series) and to 39 alone (in the 40-39 series).

2nd. Revive and strengthen after the fatiguing process of columns 15-24, by means of punishment the tendency to react to 40 alone in both series and to revive and strengthen in the 40-39 series the reaction tendency to 40, and thru lack of punishment and through repetition to discourage the tendency to react to 39.

3rd. To discover any tendency to react to 40 and not to 39, i. e., to discriminate between 40 and 39 whose intensity difference is subliminal. An examination of the critical period, namely columns 15-24 in both series shows—graphs 1, 2, 3 and 4 a rapid falling off in efficiency, (in the number of reactions made to sound without shock). The greatest loss occurs in columns 15-25. This is due in both series to the fact that an effort was made in those columns to discourage this tendency to react to the secondary stimulus. But for each sub-

ject, as each graph shows, there is a much greater falling off in the 40-39 series than in the 40 series. Since (to repeat) in both series the presentation of stimuli was the same, the number of stimuli was the same, the effort to bring about fatigue was the same the greater loss in efficiency in the 40-39 series was due to the substitution at column 15 of 39 for 40 in the 40-39 series.

Below are the averages for each subject for each series for columns 15-40, the P. E. of the difference between the series for each subject and the difference in P. E. units:

Subject	Av. 40-40	Av. 40-39	P.E. diff.	Diff. in P.E. units
J. W.	72 19.67	28 27.19	6.5	6.7
A. P.	65 6.2	9.6 1.7	6.4	9
Robison	52 15.6	34.2 13.4	4	4.4
Composite	63 19.5	19 14.09	3.1	14.1

That the greater falling off in the efficiency after column 15 in the 40-39 series is not due to the training period, columns 1-14, is seen by the negligible P. E. of the difference 5.6 or 0.06 in P. E. Units for three subjects in their performances in each series for the columns 1-14.

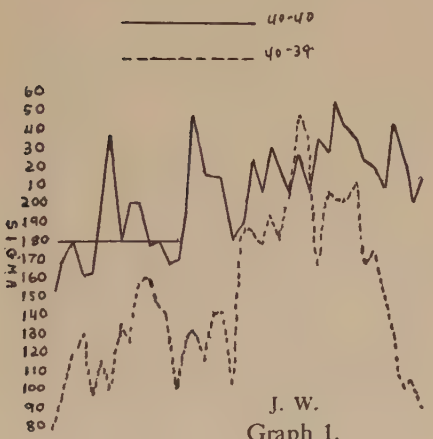
A study of the reaction time records for each subject tables 1, 2, 3, 4, 5, 6, 7, 8 and graphs, 1, 2, 3 and 4, shows the following:

1. That the reaction times are too large for the experiment to be on the reflex level.

2. If each column of the graph of the percentage of correct responses to sound alone is compared with the corresponding column in the graph of the reaction time to sound plus shock, it will be seen that, in most cases, wherever there is a falling off in the percentage of correct response to sound alone there is an increase in the corresponding column of the average reaction time to sound plus shock. It is to be noticed, also, that wherever a column shows an increase in the percentage of correct responses to sound without shock, there is in most cases to be found a decrease in the reaction time to sound plus shock of the corresponding column. Further, it is to be noticed that this increase or decrease in the percentage of correct responses to sound alone is, in most cases, accompanied by a proportional increase or decrease in the average reaction time to sound plus shock. That is to say, if the decrease or increase in the percentage of correct responses to sound without shock is great or sudden, the decrease or increase in the average reaction time to sound with shock of that column is proportionally great or sudden. On the other hand, if the increase or decrease in the percentage of correct responses is small, the corresponding column will show a proportionally small increase or decrease in the reaction time to sound plus shock. An

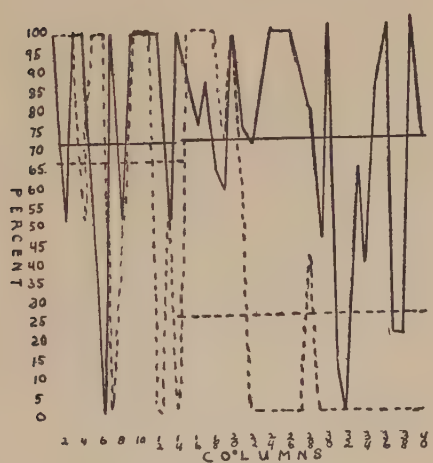
EXPERIMENT 1.

Reaction time to sound with shock. Each point is average of reactions to sound plus shock in each column of experimenter's record sheet.



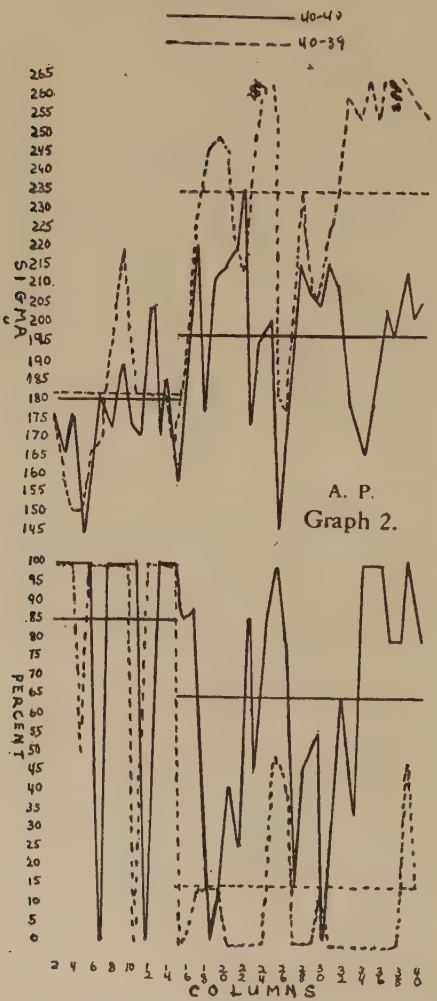
J. W.

Graph 1.



EXPERIMENT I.

Reaction time to sound plus shock. Each point is average of reactions to sound plus shock in each column of experimenter's record sheet.

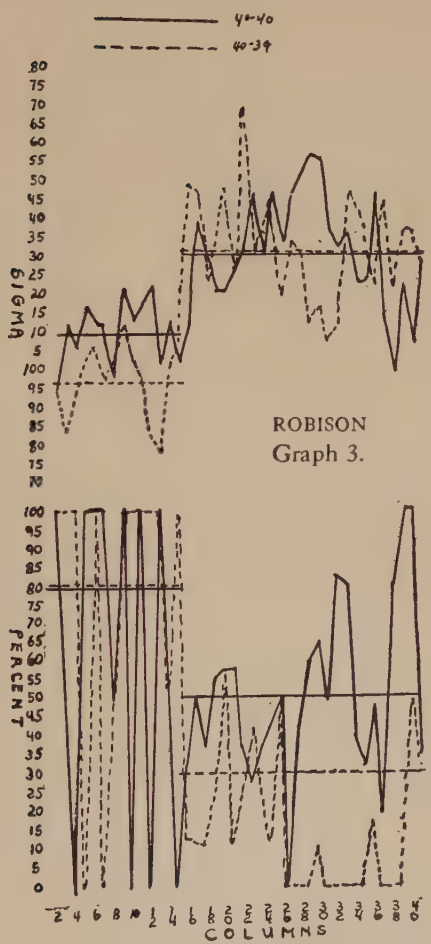


Each point is percentage of reactions to sound without shock for each column on experimenter's record sheet.

Experiment 1—Graph 3

EXPERIMENT I.

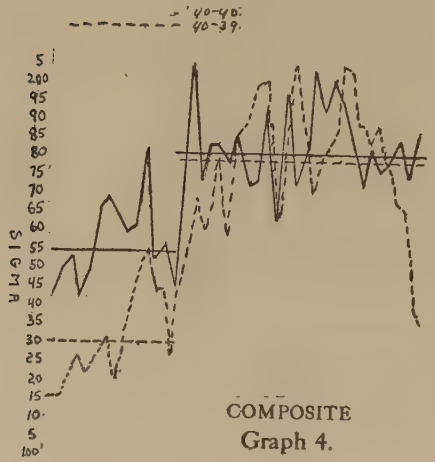
Reaction time to sound plus shock. Each point is average of number of reactions to sound plus shock in each column of experimenter's record sheet.



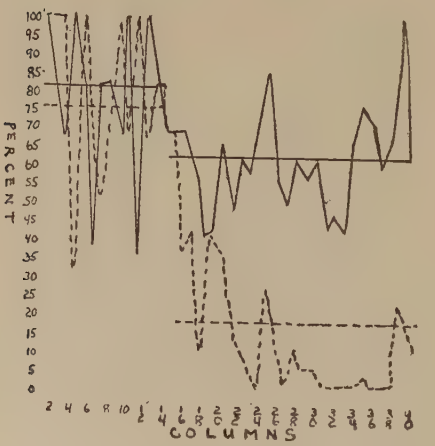
Each point is percentage of reactions to sound without shock for each column on record sheet of experimenter.

EXPERIMENT 1.

Reaction time to sound plus shock. Each point is average of number of reactions to sound plus shock for each column of experimenter's record sheet.



Graph 4.



COMPOSITE 3 SUBJECTS.

Each point is percentage of reactions to sound without shock in each column.

Series 40-40

Table 1

Table showing by columns the number of sounds with shock, the number of sounds without shock, the number of sounds without shock reacted, the per cent of response to sound without shock and the average reaction time to sound with shock.

Series 40-40

Subject	No. Sounds With Shock	No. Sounds Without Shock	No. Sounds Without Shock Reacted to	Percent Response to Sound Without Shock	Average Reaction Time to Sound With Shock	Column on Record Sheet
Robison	19	1	1	100	98.5	1
	18	2	1	50	115	2
	19	1	..	..	108	3
	18	2	2	100	118.5	4
	18	2	2	100	116.5	5
	19	1	1	100	116	6
	18	2	1	50	102.5	7
	18	2	2	100	124.5	8
	19	1	..	..	117	9
	19	1	1	100	122.5	10
	19	1	..	..	125	11
	19	1	1	100	103	12
	18	2	1	50	115.5	13
	19	1	..	..	109	14
	13	7	2	28.5	115	15
	12	8	4	50	143.5	16
	12	8	3	37	135	17
	11	9	5	55	124.5	18
	13	7	4	57	124	19
	13	7	4	57	130.5	20
	12	8	3	37	135	21
	13	7	2	28	150.5	22
	12	8	3	37	132	23
	11	9	4	44	148.5	24
	18	2	1	50	136	25
	14	6	..	..	151.5	26
	13	7	3	42	154.5	27
	15	5	3	60	102.5	28
	11	9	6	66	160.5	29
	14	6	3	50	140	30
	14	6	5	83	134	31
	14	6	5	83	137	32
	14	6	3	50	129.5	33
	17	3	1	33	129.5	34
	14	6	3	50	154	35
	16	4	1	25	116.5	36
	15	5	4	80	102	37
	15	5	5	100	127	38
	18	2	2	100	110.5	39
	14	6	2	33	140	40

Table 2

Table showing by columns the number of sounds with shock, the number of sounds without shock, the number of sounds without shock reacted to, the percentage of response to sound without shock and the average reaction time to sound with shock.

Series 40-40

Subject	No. Sounds With Shock	No. Sounds Without Shock	No. Sounds Without Shock Reacted to	Percent Response to Sound Without Shock	Average Reaction Time to Sound With Shock	Column on Record Sheet
A. P.	19	1	1	100	176.5	1
	18	2	2	100	164	2
	19	1	1	100	175.5	3
	18	2	2	100	144.5	4
	18	2	2	100	166.5	5
	19	1	..	..	180	6
	18	2	2	100	172.5	7
	18	2	2	100	192.5	8
	19	1	1	100	174.5	9
	19	1	1	100	172	10
	19	1	..	..	204	11
	19	1	1	100	171.5	12
	18	2	2	100	180.5	13
	19	1	1	100	159	14
	13	7	6	85	153.5	15
	12	8	7	87	224.5	16
	12	8	4	50	173.5	17
	11	9	..	..	212.5	18
	13	7	1	14	215.5	19
	13	7	3	43	221.5	20
	12	8	2	25	237.5	21
	13	7	6	85.5	172.5	22
	12	8	4	50	192.5	23
	11	9	8	88	202	24
	18	2	2	100	146.5	25
	14	6	5	83	179.5	26
	13	7	1	14	217	27
	15	5	4	80	208	28
	11	9	5	55.5	204	29
	14	6	..	..	219	30
	14	6	2	33	211.5	31
	14	6	4	66	188	32
	14	6	2	33	173	33
	17	3	3	100	165	34
	14	6	6	100	181	35
	16	4	4	100	202	36
	15	5	4	80	191.5	37
	15	5	4	80	216.5	38
	18	2	2	100	199	39
	14	6	5	83	203	40

Series 40-40

Table 3

Table showing by columns the number of sound with shock, the number of sound without shock, the number of sound without shock reacted to, the percentage of response to sound without shock, the average reaction time to sound with shock.

Series 40-40

Subject	No. Sounds With Shock	No. Sounds Without Shock	No. Sounds Without Shock Reacted to	Percent Response to Sound Without Shock	Average Reaction Time to Sound With Shock	Column on Record Sheet
J. W. ----	19	1	1	100	151.5	1
	18	2	1	50	166	2
	19	1	1	100	176	3
	18	2	2	100	159.5	4
	18	2	1	50	160	5
	19	1	..	..	202.5	6
	18	2	2	100	232	7
	18	2	1	50	177	8
	19	1	1	100	196	9
	19	1	1	100	196	10
	19	1	1	100	175.5	11
	19	1	1	100	176.5	12
	18	2	1	50	167	13
	19	1	1	100	169	14
	13	7	6	85	193.5	15
	12	8	6	75	242	16
	12	8	7	87.5	213	17
	11	9	6	66	213.5	18
	13	7	4	57	213.5	19
	13	7	7	100	174.5	20
	12	8	6	75	186.5	21
	13	7	5	71	233	22
	12	8	7	87.5	198.5	23
	11	9	9	100	228	24
	18	2	2	100	213.5	25
	14	6	6	100	209.5	26
	13	7	6	85	226	27
	15	5	4	80	206.5	28
	11	9	4	44	231.75	29
	14	6	6	100	225	30
	14	6	1	16	251.5	31
	14	6	..	..	238	32
	14	6	4	66	232	33
	17	3	1	33	220	34
	14	6	5	83	217.5	35
	16	4	4	100	205	36
	15	5	1	20	243.5	37
	15	5	1	20	221.5	38
	18	2	2	100	197.5	39
	14	6	4	60	218	40

Table 4

Table showing the number of sounds with shock, the number of sounds without shock, the number of sounds without shock reacted to, the percentage of response to sound without shock and the average reaction time to sound with shock.

Series 40-40

Subject	No. Sounds With Shock	No. Sounds Without Shock	No. Sounds Without Shock Reacted to	Percent Response to Sound Without Shock	Average Reaction Time to Sound With Shock	Column on Record Sheet
Composite, three subjects	19	1	1	100	142.6	1
	18	2	1.3	66.6	148.3	2
	19	1	.66	66.6	153.3	3
	18	2	2	100	141.3	4
	18	2	1.66	83	148	5
	19	1	.33	33	166.3	6
	18	2	1.66	83	169.3	7
	18	2	1.66	83	165	8
	19	1	.33	66.6	162.6	9
	19	1	1	100	163.6	10
	19	1	.33	33	181.6	11
	19	1	1	100	150.6	12
	18	2	1.33	66.6	154.6	13
	19	1	.66	66.6	145.6	14
	13	7	4.66	67.6	154.6	15
	12	8	5.66	70.6	203.6	16
	12	8	4.66	58.1	174	17
	11	9	3.66	40.3	184	18
	13	7	3	42.6	184.6	19
	13	7	4.66	66.6	176	20
	12	8	3.66	46.6	186.6	21
	13	7	4.33	61.5	174.3	22
	12	8	4.66	58.1	174.6	23
	11	9	7	77.3	193	24
	18	2	1.66	66.6	165.6	25
	14	6	3.66	61	180.6	26
	13	7	3.33	47	199.3	27
	15	5	3.66	73.3	172.6	28
	11	9	5	55.1	199	29
	14	6	3	50	194.6	30
	14	6	2.66	44	199.3	31
	14	6	3	49.6	187.6	32
	14	6	3	49.6	178.3	33
	17	3	1.33	55.3	171.6	34
	14	6	4.66	77.6	184.3	35
	16	4	3	75	174.6	36
	15	5	3	60	179.3	37
	15	5	3.33	66.6	188.6	38
	18	2	2	100	169.3	39
	14	6	3.66	58.6	187.3	40

Series 40-39

Table 5

Table showing by columns the number of sounds with shock, the number of sounds without shock, the number of sounds without shock reacted to, the percentage of response to sound without shock and the average reaction time to sound with shock.

Series 40-39

Subject	No. Sounds With Shock	No. Sounds Without Shock			No. Sounds Without Shock Reacted to			Percent Response to Sound Without Shock	Average Reaction Time to Sound With Shock	Column on Record Sheet
		40	39	T	40	39	T			
Robison .	19	1	.	1	1	.	1	100	96	1
	18	2	.	2	2	.	2	100	85.5	2
	19	1	.	1	1	.	1	100	95.75	3
	18	2	.	2	.	.	.	.....	106	4
	18	2	.	2	2	.	2	100	109	5
	19	1	.	1	.	.	.	.....	101	6
	18	2	.	2	1	.	1	50	104	7
	18	2	.	2	2	.	2	100	117	8
	19	1	.	1	1	.	1	100	104	9
	19	1	.	1	1	.	1	100	100.5	10
	19	1	.	1	1	.	1	100	86	11
	19	1	.	1	1	.	1	100	80.5	12
	18	2	.	2	1	.	1	50	104	13
	19	1	.	1	1	.	1	100	106.5	14
	13	.	7	7	.	1	1	14.2	154	15
	12	.	8	8	.	1	1	12	151	16
	12	1	7	8	.	1	1	12	126	17
	11	1	8	9	.	2	2	25	139.5	18
	13	1	6	7	1	3	4	57	157	19
	13	1	6	7	.	1	1	14.2	129	20
	12	2	6	8	.	2	2	25	173	21
	13	2	5	7	.	3	3	42	135	22
	12	2	6	8	.	2	2	25	139.5	23
	11	1	8	9	.	1	1	11	152	24
	18	2	.	2	1	.	1	50	122.5	25
	14	1	5	6	.	.	.	.....	139.5	26
	13	2	5	7	.	.	.	.....	136	27
	15	2	3	5	.	.	.	.....	114	28
	11	3	6	9	.	1	1	11	120.5	29
	14	1	5	6	.	.	.	.....	109	30
	14	1	5	6	.	.	.	.....	115.5	31
	14	2	4	6	.	.	.	.....	154	32
	14	4	2	6	.	.	.	.....	146.5	33
	17	2	1	3	.	.	.	.....	125	34
	14	4	2	6	1	.	1	16	125	35
	16	3	1	4	.	.	.	.....	148	36
	15	5	.	5	.	.	.	.....	125	37
	15	5	.	5	.	.	.	.....	138.5	38
	18	2	.	2	.	1	1	50	137.5	39
	14	5	1	6	1	1	2	33.3	131	40

Table 6

Table showing by columns the number of sounds plus shock, the number of sounds without shock, the number of sounds without shock reacted to, the percentage of response to sound without shock and the average reaction time to sound with shock.

Series 40-39

Subject	No. Sounds With Shock	No. Sounds Without Shock			No. Sounds Without Shock Reacted to			Percent Response to Sound Without Shock	Average Reaction Time to Sound With Shock	Column on Record Sheet
		40	39	T	40	39	T			
A. P.	19	1	.	1	1	.	1	100	174.5	1
	18	2	.	2	2	.	2	100	160.2	2
	19	1	.	1	1	.	1	100	153.7	3
	18	2	.	2	1	.	1	50	150.7	4
	18	2	.	2	2	.	2	100	165	5
	19	1	.	1	1	.	1	100	172.5	6
	18	2	.	2	2	.	2	100	196.6	7
	18	2	.	2	2	.	2	100	221.5	8
	19	1	.	1	1	.	1	100	195.2	9
	19	1	.	1	.	.	.	.....	173.5	10
	19	1	.	1	1	.	1	100	218.5	11
	19	1	.	1	1	.	1	100	209	12
	18	2	.	2	2	.	2	100	194	13
	19	1	.	1	1	.	1	100	168	14
	13	.	7	7	.	.	.	.....	186	15
	12	.	8	8	.	.	.	.....	231.7	16
	12	1	7	8	.	1	1	12.5	249	17
	11	1	8	9	1	.	1	11	246	18
	13	1	6	7	1	.	1	14	243	19
	13	1	6	7	.	.	.	.....	225	20
	12	2	6	8	.	.	.	.....	216	21
	13	2	5	7	.	.	.	.....	246	22
	12	2	6	8	.	.	.	.....	284.5	23
	11	1	8	9	.	.	.	.....	261	24
	18	2	.	2	1	.	1	50	181.5	25
	14	1	5	6	.	2	2	33.3	177.5	26
	13	2	5	7	.	.	.	.....	236	27
	15	2	3	5	.	.	.	.....	210.5	28
	11	3	6	9	.	.	.	.....	206	29
	14	1	5	6	.	1	1	16.6	223	30
	14	1	5	6	.	.	.	.....	236.5	31
	14	2	4	6	.	.	.	.....	265	32
	14	4	2	6	.	.	.	.....	256.5	33
	17	2	1	3	.	.	.	.....	275.5	34
	14	4	2	6	.	.	.	.....	255	35
	16	3	1	4	.	.	.	.....	271	36
	15	5	.	5	.	.	.	.....	288	37
	15	5	.	5	.	.	.	.....	271.5	38
	18	2	.	2	1	.	1	50	259	39
	14	5	1	6	1	.	1	16	259.5	40

Table 7

Table showing by columns the number of sounds plus shock, the number of sounds without shock, the number of sounds without shock reacted to, the percentage of response to sound without shock, the reaction time to sound with shock.

Series 40-39

Subject	No. Sounds With Shock	No. Sounds Without Shock			No. Sounds Without Shock Reacted to			Percent Response to Sound Without Shock	Average Reaction Time to Sound With Shock	Column on Record Sheet
		40	39	T	40	39	T			
J. W.	19	1	.	1	1	.	1	100	77.5	1
	18	2	.	2	2	.	2	100	101	2
	19	1	.	1	1	.	1	100	115.5	3
	18	2	.	2	1	.	1	50	127	4
	18	2	.	2	2	.	2	100	94	5
	19	1	.	1	1	.	1	100	108.5	6
	18	2	.	2	.	.	.	.....	98.5	7
	18	2	.	2	1	.	1	50	127.5	8
	19	1	.	1	1	.	1	100	122.5	9
	19	1	.	1	1	.	1	100	155	10
	19	1	.	1	1	.	1	100	159.5	11
	19	1	.	1	.	.	.	.....	143	12
	18	2	.	2	1	.	1	50	137	13
	19	1	.	1	.	.	.	.....	97	14
	13	.	7	7	.	7	7	100	125.5	15
	12	.	8	8	.	8	8	100	128	16
	12	1	7	8	1	7	8	100	113.5	17
	11	1	8	9	1	8	9	100	137	18
	13	1	6	7	.	5	5	71.4	139	19
	13	1	6	7	1	6	7	100	101	20
	12	2	6	8	2	3	5	62.5	180	21
	13	2	5	7	.	.	.	.....	186	22
	12	2	6	8	.	.	.	.....	175	23
	11	1	8	9	.	.	.	.....	193.5	24
	18	2	.	2	.	.	.	.....	178	25
	14	1	5	6	.	.	.	.....	200	26
	13	2	5	7	.	.	.	.....	246	27
	15	2	3	5	1	1	2	40	233.5	28
	11	3	6	9	.	.	.	.....	164	29
	14	1	5	6	.	.	.	.....	205.5	30
	14	1	5	6	.	.	.	.....	200	31
	14	2	4	6	.	.	.	.....	200.5	32
	14	4	2	6	.	.	.	.....	212.5	33
	17	2	1	3	.	.	.	.....	167	34
	14	4	2	6	.	.	.	.....	171.5	35
	16	3	1	4	.	.	.	.....	150	36
	15	5	.	5	.	.	.	.....	131.5	37
	15	5	.	5	.	.	.	.....	97	38
	18	2	.	2	.	.	.	.....	101	39
	14	5	1	6	.	.	.	.....	87	40

Table 8

Table showing by columns the number of sounds with shock, the number of sounds without shock, the number of sounds without shock reacted to, the percentage of response to sound without shock, and the average reaction time to sound with shock.

Series 40-39

Subject	No. Sounds With Shock	No. Sounds Without Shock			No. Sounds Without Shock Reacted to			Percent Response to Sound Without Shock	Average Reaction Time to Sound With Shock	Column on Record Sheet
		40	39	T	40	39	T			
Composite three subjects	19	1	...	1	1	....	1	100	116.3	1
	18	2	...	2	2	....	2	100	115.6	2
	19	1	...	1	1	....	1	100	122	3
	18	2	...	2	.66	....	.66	.33	126	4
	18	2	...	2	2	....	2	100	122.6	5
	19	1	...	1	.66	....	.66	.66	125.7	6
	18	2	...	2	1	....	1	.50	133.3	7
	18	2	...	2	1.66	....	1.66	83	119	8
	19	1	...	1	1	....	1	100	130.6	9
	19	1	...	1	.66	....	.66	66	143.3	10
	19	1	...	1	1	....	1	100	155	11
	19	1	...	1	.66	....	.66	66	144.3	12
	18	2	...	2	1.33	....	1.33	66	145	13
	19	1	...	1	.66	....	.66	66	124	14
	13	...	7	7	....	2.6	2.6	38	155.3	15
	12	...	8	8	....	3	3	37	170.6	16
	12	1	7	8	.33	3	3.33	41	163	17
	11	1	8	9	.66	3.3	4	45	174.3	18
	13	1	6	7	.66	2.6	3.33	46	179.6	19
	13	1	6	7	.33	2.3	2.66	38	152	20
	12	2	6	8	.66	1.6	2.33	29	189.6	21
	13	2	5	7	....	1	1	14	189	22
	12	2	6	8	....	.66	.66	8	200	23
	11	1	8	9	....	.33	.33	3	203.3	24
	18	2	...	2	.66	....	.66	33	161	25
	14	1	5	6	....	.66	.66	11	172	26
	13	2	5	7	....	....	....	...	206	27
	15	2	3	5	.33	.33	.66	13	186.3	28
	11	3	6	9	....	.33	.33	3	163.6	29
	14	1	5	6	....	.33	.33	5	179.3	30
	14	1	5	6	....	....	....	...	183.6	31
	14	2	4	6	....	....	....	...	206.6	32
	14	4	2	6	....	....	....	...	205.6	33
	17	2	1	3	....	....	....	...	189.3	34
	14	4	2	6	.33	....	.33	5	184	35
	16	3	1	4	....	....	....	...	189.6	36
	15	5	...	5	....	....	....	...	181.6	37
	15	5	...	5	....	....	....	...	169.3	38
	18	2	...	2	.33	.33	.33	33	166	39
	14	5	1	6	.66	.33	1	16	142.6	40

attempt was made to check up this assertion. For each subject in the 40-40 series the correlation was found between the percentage of correct responses to sound without shock and the average reaction time to sound with shock for that critical portion of the series, columns 15 to 40. The correlations (see table 9) are surprisingly high when it is considered that the arrangement by columns is arbitrary, and that it often happened that the change in reaction time to sound plus shock did not take place until a column after the change in percentage of correct response to sound without shock which had been offered at the end of the previous column.

In the 40-39 series it was difficult, because of the number of zero responses to sound without shock to find correlations similar to those found in the 40-40 series. The best that could be done was to find the average reaction time to sound with shock for those columns in which the response to sound without shock had been from zero to forty nine percent and compare these reaction times to sound with shock with those of the columns in which the responses to sound without shock had been from 50 to 100 percent. It will be found almost uniformly (Table 10) that the average reaction time to sound with shock for these columns in which the percentage of response to sound without shock had been from zero to forty-nine percent is greater than the reaction time to sound with shock for those columns in which the percentages of correct response to sound without shock had been from 50-100 percent. Table 9 was computed from Tables 1-8.

3. The greatest change in the percentage of correct response to sound without shock occurs after column 14. The graphs for reaction time to sound plus shock shows the greatest increase also after column 14.

4. That series in which, after column 14, 39 was substituted for 40, (whenever sound without shock was offered) shows the greatest change. This change is a decided decrease in the percentage of correct response to sound without shock. The graph for reaction time to sound plus shock shows that the greatest change occurs (an increase in the average reaction time per column to sound with shock) in that series in which 39 is substituted for 40 (whenever offered alone.)

Correlations for columns 15-40 in the 40-40 series between the reaction time to sound with shock and percentage of correct response to sound without shock.

Table 9

Subject	Correlation	P.E.
Robison	—.27	.12
A. P.	—.497	.006
J. W.	—.568	.08
Composite	—.445	.068

Comparison for columns 15 to 40 in the 40-39 series between reaction time for sound with shock and the percent correct responses for sound without shock for those two column groups whose percentages are from 0 to 49 and from 50 to 100.

Table 10

Subject	Av. reaction time for those columns whose per cent correct response is from 0-49	Av. reaction time for those columns whose per cent correct response is from 50-100	Difference
Robison	136.3	139	—2.7
A. P.	242.4	220.4	22.
J. W.	201.1	132	69.1
Composite	193.2	163.6	29.6

Tentative Interpretation

The fact that the percentage of correct response to sound without shock for a column and the reaction time to sound with shock for that column vary together and proportionally means either that one influences the other or that both are influenced by some common factor. It might be said that for every column the decrease in the percentage of correct response to sound alone caused an increase for that column of the reaction time to sound plus shock. For, it might be argued, since there was at no time a ready signal given, the subject, sitting quietly in a dark room, would tend to become inattentive, perhaps half asleep. Thus his reaction time to sound plus shock would tend to become very slow. Indeed, we do find that the reaction time runs as high as 280 sigma. If now, two or three sounds without shock are offered him and are ignored, the subject will sit there doing nothing and will become more inattentive. Then when sound plus shock is suddenly again offered, he is unprepared and his reaction is slow. The greater the number of sounds without shock he ignores in any one column, the greater will be his inattention and

so the greater will be the reaction time to the remaining sound plus shock offerings of that column. This, then, would explain why the decrease in the percentage of correct responses to sound without shock in any column would show for that column an increase in the reaction time to sound plus shock. Likewise, it might in the same way be argued that when the subject did react to sound without shock there was less likelihood of his becoming inattentive thru inaction, and so one might expect to find that the reaction time to the sound plus shock comparatively fast. Therefore the higher the percentage of correct responses to sound without shock in a column, the faster would be, for that column, the reaction time to sound plus shock. Thus would be explained the concomitant rise and fall in the reaction times to sound plus shock of the various columns with the decrease and increase in the percentage of correct responses to sound without shock of the corresponding columns.

Now, since the greatest falling off in both series in their percentage of correct responses to sound without shock takes place after column 14, it can be seen why in each column there is such a sudden increase in the reaction times to sound plus shock after column 14. Also, since it was found that there is a greater loss in the percentage of correct responses to sound without shock for the 40-39 series than in the 40-40 series, it can readily be seen why there is a greater increase in reaction time to the sound plus shock in the 40-39 series than in the 40-40 series. The above attempt at interpretation does not, however, give any clue as to why there should be such a decrease in the percentage of correct responses to sound without shock when, after column 14, 39 was substituted for 40 whenever offered without shock.

It might then be said that the subject becoming, for some reason, inattentive or sleepy, became very slow, and his reaction time therefore increased. This sleepiness would make for a disinclination to react; but this disinclination was always overcome by the shock when the sound plus shock was offered. But when sound came without shock, the disinclination to react had nothing to combat it, and the subject failed to react. Thus, whenever the reaction time to sound plus shock went up, it hinted at an increasing inattentiveness and sleepiness, and so it was to be expected that his percentage of reactions to sound without shock would fall. Likewise, whenever the subject was less sleepy and inattentive, his reaction time to sound

plus shock would decrease, and, not being so disinclined to react, he is likely to react to sound without shock. Then a decrease in reaction time to sound plus shock would show a concomitant increase in the percentage of correct response to sound without shock. And that is what we find.

But this interpretation, too, is faulty. It does not explain why this inattentiveness should become so suddenly potent in both series after column 14. Nor does it explain why there should be so much greater inattentiveness in the 40-39 series than in the 40-40 series. For if this explanation were the correct one the greater loss in the percentage of correct responses in the 40-39 series could only be caused by the greater inattentiveness in that series.

To summarize:—

1. The decrease in the percentage of correct response to sound without shock caused the subject to sit idle, half asleep and inattentive. Because of this condition of inattentiveness, the subject would be unprepared for the sound plus shock stimulus and this would increase his reaction time to sound plus shock. But this does not explain why there should be a period of no response to sound without shock, nor does it explain why the percentage of response to sound without shock should fall so low at the introduction of 39.

2. The increase in the reaction time to sound plus shock may be the result of a feeling of sleepiness and inattention. Thus a sudden increase in the reaction time to sound plus shock would indicate a sudden increase in this feeling of sleepiness. This sleepiness would cause a disinclination to react to stimuli. This disinclination is fought and partially overcome by the shock when the sound plus shock is offered and the reaction is slow. But when the sound is offered without shock there is no spur to reaction and the sound without the shock is very often ignored. But this does not explain why there is a greater disinclination to reaction in the 40-39 series than in the 40-40 series causing, as a result, a greater loss in the percentage of correct response to sound without shock in the 40-39 series than in the 40-40 series.

Another factor enters here which, making use of the above theories, may explain both the loss in the percentage of correct response to sound without shock when 39 was submitted for 40. It might be said that as the experiment continued, the stimuli became less and less intense because of central fatigue. Thus, when 39, less intense than

40 was substituted for 40, this central fatigue was accentuated. When this occurred, the habit of reacting to sound alone, being at best but a feebly built-up habit, was quickly broken up. This would explain the greater loss in the percentage of reaction to 39 alone than to 40 alone. This failure to react, then, as above tentatively interpreted would lead, because of the resulting inattention, to an increase in the reaction time to sound plus shock.

If this is true, it might be said then, that the subject manifested an ability to distinguish between 40 and 39 in the following manner:

1. There is a decrease in the percentage of correct response to sound without shock when the sound 39 without shock was substituted for 40 without shock.

2. A loss in the percentage of correct response to sound without shock leads to a concomitant increase in the reaction time to the sound plus shock.

3. There is a greater increase in the reaction time to sound plus shock in columns 15-40 inclusive over columns 1-14 inclusive in the 40-39 series than in the 40-40 series because of the accentuation in the 40-39 series of central fatigue by the substitution for 40 of the sound 39. This theory is experimentally tested below in experiment No. 2.

Conclusions up to this point.

1. The reaction times show that the above experiment was not on a reflex level.

2. The experiment may be called a conditioned reaction experiment since no ready signal was given, shock was used as a primary stimulus in combination with sound as the secondary stimulus, sound was at certain times offered without shock and no instructions were given to the subject.

3. The subjects show an ability to differentiate between 39 and 40, two sounds which differ by an amount which is "subliminal."

4. This ability is evidenced as follows:—

a. As long as the secondary stimulus is kept at a constant intensity, the reaction tendency to that stimulus will, even when an effort is made to fatigue it, remain fairly strong.

b. As soon as the secondary stimulus is changed in intensity by an amount which is so small that it may be called subliminal, the subject will almost entirely lose the tendency to react to the original, familiar stimulus.

c. After the change in the secondary stimulus, whenever the subject does react to it, the reaction is both to the familiar and unfamiliar stimulus.

d. After the change in the secondary stimulus whenever there is failure to react to it the failure to react is both to the familiar and the unfamiliar secondary stimulus, indiscriminately.

e. A decrease in the number of reactions to the secondary stimuli, is accompanied by an increase in the reaction times to the sound plus shock stimuli.

f. An increase in the number of reactions to the secondary stimulus is accompanied by a decrease in the reaction time to the sound plus shock stimuli.

VI. EXPERIMENT No. 2.

The following experiment was undertaken to see if the theory based on the factor of central fatigue is adequate to explain the results obtained in experiment 1. Each of the following experiments consists of three series, viz; a constant series using sound 39 through out; a series in which at a certain point 38 was substituted for 39; and a series in which at the same fixed point 40 was substituted for 39. If central fatigue is the casual factor in the loss in percentage of correct response to sound without shock, then at a certain point in the experiment when sound 39 was to be thought of as becoming less intense, the substitution for 39 of the sound 40 should make up for this loss in intensity and, presumably, there should take place no great loss in the reaction habit to sound without shock.

Two graduate students, one in psychology, working for the doctorate and thoroly practiced in reaction time experiments; the other the same A. P. as in experiment 1, a graduate student of electrical engineering, whose knowledge of conditioned reflex was not very much greater than it had been before the first experiment, since there had been no discussion with him of any of the results.

Instructions.

None. Since each was practiced in reaction time procedure, probably none was needed.

Method:

Seated subject on swivel chair, telephone receiver strapped to his head, and hand and finger placed on the electrodes. Same apparatus as in experiment 1. Three intensities of sound were used, 39, 38 and 40. Each subject was put through the three series, one in which 39 was retained thruout, one in which at a certain point in the series, 38 was substituted for 39, and one in which, at the same point, 40 was substituted for 39. Each series consisted of 225 reactions of which 55 were to sound without shock. Each subject was given in each series 100 reactions to sound plus shock before any effort was made to offer sound alone to see if the subject showed any evidence of being conditioned. An effort was made after the 100th reaction to thoroly fatigue the tendency to react to sound without shock by repeating the sound alone five times in succession for every ten repetitions of sound plus shock. This was done to give the tendency to

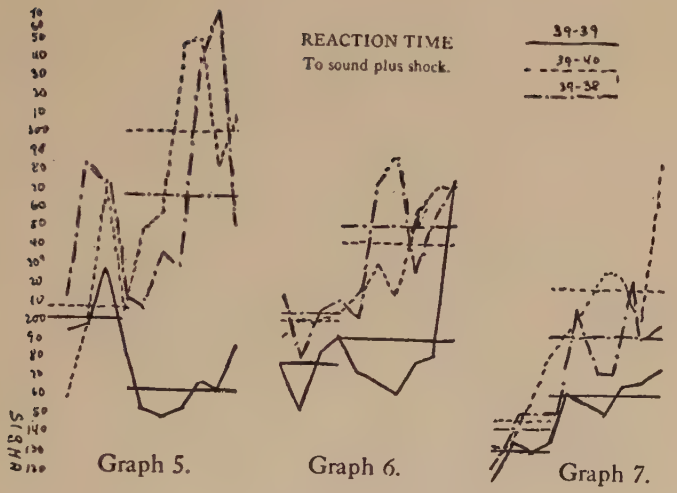
react to the secondary stimulus every impetus to weaken and disappear in the 39-39 series where the intensity of the sound was presumably constant thruout. The series were given in the following order:

H's series ran 39-40, 39-38, and 39-39. The series was repeated with H once more in the following order,—39-39, 39-40, and 39-38. The A. P. series ran 39-39, 39-40 and 39-38.

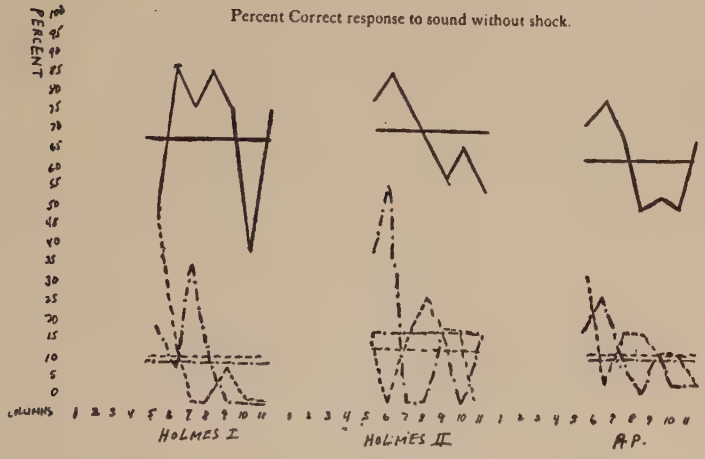
Results:

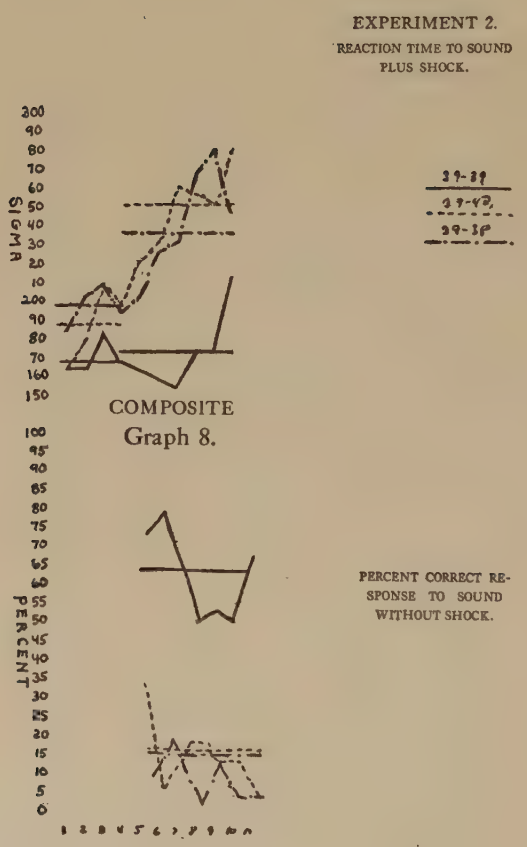
They are comparable to the results obtained in experiment 1. Graphs 5, 6, 7 and 8, the composite of the three, show that the percentage of correct response to sound without shock remained high in spite of all effort to fatigue the tendency; while in the series 39-38 and 39-40, with the same number of stimuli, the same order of presentation and the same method of fatiguing the tendency to react to sound without shock, there is found a great deduction in the number of correct responses to sound without shock. The reaction time graph shows also, as in experiment 1, a fairly close concomitant increase and decrease in the reaction time to sound plus shock with the increase and decrease in the percentages of responses to sound without shock. (See tables 11 to 16).

Experiment 2. Graphs 5, 6 and 7



Graph 5. Graph 6. Graph 7.





COMPOSITE
Graph 8.

Series 39-39

Table 11

Table showing by columns the number of sounds with shock, the number of sounds without shock, the number of sounds without shock reacted to, the percentage of response to sound without shock and the reaction time to sound with shock.

Series 39-39

Subject	No. Sounds With Shock	No. Sounds Without Shock	No. Sounds Without Shock Reacted to	Percent Response to Sound Without Shock	Average Reaction Time to Sound With Shock	Column on Record Sheet
A. P.	25	..	..	..	120.5	1
	25	..	..	..	142.5	2
	25	..	..	..	137	3
	25	..	..	..	140.8	4
	15	10	10	100	169	5
	15	10	7	70	159.5	6
	20	5	3	60	154	7
	15	10	..	..	169	8
	15	10	3	30	172.5	9
	20	5	2	40	177.8	10
	..	5	4	80	.....	11
Holmes 1	25	..	..	..	199.5	1
	25	..	..	..	200.5	2
	25	..	..	..	231.7	3
	25	..	..	..	182.5	4
	15	10	5	50	158	5
	15	10	9	90	154	6
	20	5	4	80	159	7
	15	10	9	90	169.5	8
	15	10	8	80	166.8	9
	20	5	2	40	186	10
	..	5	4	80	..	11

Table 12

Table showing by columns the number of sounds with shock, the number of sounds without shock, the number of sounds without shock reacted to, the percentage of response to sound without shock and the average reaction time to sound with shock.

Series 39-39

Subject	No. Sounds With Shock	No. Sounds Without Shock	No. Sounds Without Shock Reacted to	Percent Response to Sound Without Shock	Average Reaction Time to Sound With Shock	Column on Record Sheet
Holmes 2	25	..	..	..	180	1
	25	..	..	..	155	2
	25	..	..	..	186	3
	25	..	..	..	192.6	4
	15	10	8	80	176	5
	15	10	9	90	171	6
	20	5	4	80	164	7
	15	10	7	70	180	8
	15	10	6	60	183.6	9
	20	5	4	80	283	10
	..	5	3	60	.....	11
Composite, three subjects	25	..	..	..	165.5	1
	25	..	..	..	166	2
	25	..	..	..	185	3
	25	..	..	..	172	4
	15	10	7.6	76	167.6	5
	15	10	8.3	83	162	6
	20	5	3.6	73	159.6	7
	15	10	5.3	53	173	8
	15	10	5.6	56	174.6	9
	20	5	2.6	53	215	10
	..	5	3.6	73	...	11

Series 39-38

Table 13

Table showing by columns the number of sounds with shock, the number of sounds without shock, the number of sounds without shock reacted to, the percentage of response to sound without shock and the average reaction time to sound with shock.

Series 39-38

Subject	No. Sounds With Shock	No. Sounds Without Shock			No. Sounds Without Shock Reacted to			Percent Response to Sound Without Shock	Average Reaction Time to Sound With Shock	Column on Record Sheet
		39	38	T	39	38	T			
A. P.	25	.	.	.	.	.	.	..	130	1
	25	.	.	.	.	.	.	..	168	2
	25	.	.	.	.	.	.	..	157.5	3
	25	.	.	.	.	.	.	..	158.5	4
	15	.	10	10	.	4	4	40	210.8	5
	15	.	10	10	.	.	.	..	178	6
	20	3	2	5	1	1	2	40	176	7
	15	5	5	10	2	1	3	30	222.6	8
	15	5	5	10	1	1	2	20	192.5	9
	20	3	2	5	1	.	1	20	204	10
	..	2	3	5	1	.	1	20	..	11
Holmes 1	25	.	.	.	.	.	.	..	212.7	1
	25	.	.	.	.	.	.	..	286	2
	25	.	.	.	.	.	.	..	272.5	3
	25	.	.	.	.	.	.	..	217	4
	15	.	10	10	.	5	5	50	203	5
	15	.	10	10	.	2	2	20	239	6
	20	3	2	5	.	.	.	..	234	7
	15	5	5	10	.	.	.	..	238	8
	15	5	5	10	1	.	1	10	373	9
	20	3	2	5	.	.	.	..	252	10
	..	2	3	5	.	.	.	..	..	11

Table 14

Table showing by columns the number of sounds with shock, the number of sounds without shock, the number of sounds without shock reacted to, the percentage of response to sound without shock and the average reaction time to sound with shock.

Series 39-38

Subject	No. Sounds With Shock	No. Sounds Without Shock			No. Sounds Without Shock Reacted to			Percent Response to Sound Without Shock	Average Reaction Time to Sound With Shock	Column on Record Sheet
		39	38	T	39	38	T			
Holmes 2	25	.	.	.	.	.	.	..	219	1
	25	.	.	.	.	.	.	..	178	2
	25	.	.	.	.	.	.	..	205	3
	25	.	.	.	.	.	.	..	211.9	4
	15	.	10	10	.	2	2	20	201	5
	15	.	10	10	.	.	.	..	276.6	6
	20	3	2	5	1	.	1	20	292	7
	15	5	5	10	2	1	3	30	229.7	8
	15	5	5	10	1	1	2	20	256.5	9
	20	3	2	5	1	.	1	20	239	10
	..	2	3	5	.	.	.	..	....	11
Composite	25	.	.	.	.	.	.	..	184	1
	25	.	.	.	.	.	.	..	207.6	2
	25	.	.	.	.	.	.	..	212	3
	25	.	.	.	.	.	.	..	196	4
	15	.	10	10	.	3.6	.6	36	205	5
	15	.	10	10	.	.6	.6	6	229.6	6
	20	3	2	5	.6	.3	1	20	234	7
	15	5	5	10	1.3	.6	2	20	264	8
	15	5	5	10	1	.6	1.6	16	274	9
	20	3	2	5	.6	.	.6	13	245	10
	..	2	3	5	.3	.	.3	6	..	11

Series 39-40

Table 15

Tables showing by columns the number of sounds with shock, the number of sounds without shock, the number of sounds without shock reacted to, the percentage of response to sound without shock and the reaction time to sound with shock.

Series 39-40

Subject	No. Sounds With Shock	No. Sounds Without Shock			No. Sounds Without Shock Reacted to			Percent Response to Sound Without Shock	Average Reaction Time to Sound With Shock	Column on Record Sheet
		39	40	T	39	40	T			
A. P.	25	.	.	.	.	.	.	..	136	1
	25	.	.	.	.	.	.	..	136	2
	25	.	.	.	.	.	.	..	152	3
	25	.	.	.	.	.	.	..	185	4
	15	.	10	10	.	1	1	10	202.6	5
	15	.	10	10	.	2	2	20	216.5	6
	20	3	2	5	.	.	.	..	231.7	7
	15	5	5	10	.	.	.	..	227	8
	15	5	5	10	1	2	3	30	205	9
	20	3	2	5	1	.	1	20	285	10
	..	2	3	5	.	.	.	..	...	11
Holmes 1	25	.	.	.	.	.	.	..	162	1
	25	.	.	.	.	.	.	..	203	2
	25	.	.	.	.	.	.	..	275	3
	25	.	.	.	.	.	.	..	208	4
	15	.	10	10	.	2	2	20	253	5
	15	.	10	10	.	1	1	10	259	6
	20	3	2	5	2	.	2	10	354	7
	15	5	5	10	.	1	1	10	354.7	8
	15	5	5	10	.	.	.	..	286	9
	20	3	2	5	.	.	.	..	313.6	10
	..	2	3	5	.	.	.	..	..	11

Table 16

Table showing by columns the number of sounds with shock, the number of sounds without shock, the number of sounds without shock reacted to, the percentage of response to sound without shock and the average reaction time to sound with shock.

Series 39-40

Subject	No. Sounds With Shock	No. Sounds Without Shock			No. Sounds Without Shock Reacted to			Percent Response to Sound Without Shock	Average Reaction Time to Sound With Shock	Column on Record Sheet
		39	40	T	39	40	T			
Holmes 2	25	.	.	.	.	.	.	..	198	1
	25	.	.	.	.	.	.	..	206	2
	25	.	.	.	.	.	.	..	207	3
	25	.	.	.	.	.	.	..	212	4
	15	.	10	10	.	4	4	40	220	5
	15	.	10	10	.	6	6	60	236	6
	20	3	2	5	.	.	.	..	213.7	7
	15	5	5	10	.	.	.	..	259.5	8
	15	5	5	10	1	1	2	20	276.7	9
	20	3	2	5	.	.	.	..	276.7	10
	..	2	3	5	1	.	1	20	..	11
Composite	25	.	.	.	.	.	.	..	165	1
	25	.	.	.	.	.	.	..	181.6	2
	25	.	.	.	.	.	.	..	211	3
	25	.	.	.	.	.	.	..	201.6	4
	15	.	10	10	.	2.3	2.3	23	225.6	5
	15	.	10	10	.	3.	3.	30	237	6
	20	3	2	5	.6	.	.6	13	266.6	7
	15	5	5	10	.	.3	.3	3	260.6	8
	15	5	5	10	.6	1.	1.6	16	256	9
	20	3	2	5	.3	.	.3	6	292	10
	..	2	3	5	.3	.	.3	6	..	11

Table 17

Correlations for columns 5-11 in series 39-39 between reaction time for sound plus shock and percentage of correct response to sound without shock.

Series 39-39

Subject	Correlation	P.E.
A. P.	—.677	.14
Holmes 1	—.32	.24
Holmes 2	—.487	.209
Composite	—.49	.19

Table 18

Comparison for columns 5-11 in series 39-40 and 39-38 between reaction time to sound and percent correct responses for sound without shock for those columns whose percentages are from 0-39 and from 40-100.

Subject		39-38	39-40
A. P.	% correct response	0- 39-199.2	0- 29-205
	% " "	40-100-193.4	30-100-232
		Diff. 5.8	Diff. 27
Holmes 1	" "	0- 39-327	0- 29-293
		40-100-203	30-100-354
		Diff. 124	Diff. 61
Holmes 2	" "	0- 39-249.1	0- 29-256.6
		40-100-no	30-100-228
		percentages	Diff. 28.6
Composite	" "	0- 49-258.5	0- 29-260.2
		40-100-198.2	30-100-262
		Diff. 60.3	Diff. 1.8

Below, for all subjects, for the three series, are the average percentage of response, the P. E. of the difference between the series, and the difference in P. E. units, for the critical period, columns 5-11.

Subject	Av. 39-39	Av. 39-38	Av. 39-40	P.E. Diff. 39-39 39-38	P.E. Diff. 39-39 39-40	Diff. in p.e. Units 39-39 39-38	Diff. in p.e. Units 39-39 39-40
Composite	66.8 ± 2.9	20.3 ± 2.9	14.6 ± 2.2	3.7	3.7	12.5	14.1

As for experiment 1. an attempt was made (see tables 17 and 18) to find the correlation between the reaction time to sound with shock and the percentages of correct responses to sound without shock for columns 5 to 11. As in experiment 1, these correlations could be obtained for the series with the non-varying sound intensity, (39-39) only, and it will be seen, table 17, how high they are. They tend to uphold the assertion that an increase in the percentage of correct

response for a column to sound without shock is usually accompanied by a decrease in the reaction time to sound with shock for that column. Difficulty was once more experienced, as in experiment 1. in trying to obtain proof for this assertain in the series 39-38 and 39-40. Some series had to be divided into two groups of percentages of correct responses from zero to thirty-nine and from forty to one hundred, whilst the others could be divided, as in experiment one, into groups from zero to forty-nine and from fifty to one hundred. Since in this experiment it often occured that five sounds without shock would be ignored or responded to at the very end of a column, the concomitant change would not come until the next column. For this reason some subjects did not show a close relation between change in a column for correct response to sound without shock and a corresponding change for those columns in the reaction time to sound with shock. The composite, however, for the 39-38 series shows the greater reaction time to sound plus shock for those columns in which the percentage of correct responses to sound without shock was low.

The purpose of this experiment was to see if the so-called central fatigue was at the basis of the reduction in the number of reactions to sound without shock. To compensate for this weakening in the intensity of the sound plus shock, the constant sound 39 was increased to 40. If the central fatigue theory were adequate, it should be found that the increase in the intensity of the sound 39 to 40 should cause an increase or at least a maintenance of the percentage of correct response to sound without shock. The results, however, show that in both series in which a change in the intensity of the sound occurred, viz. from 39 to 38, and from 39 to 40, the percentage of correct response to sound without shock fell down considerably. Only in the series 39-39, where the sound was kept constant, was there a fair maintenance of the percentage of correct response to sound without shock.

The theory of central fatigue is therefore, considered inadequate to account for the loss in percentage of correct response to sound without shock when the sound is changed in intensity.

Conclusions:

1. There is a loss in the number of correct responses to the secondary stimulus (sound without shock) when it differs from the familiar one, even tho that difference be deemed subliminal. Correct reaction, or failure to react, is indiscriminately to the unfamiliar and to the familiar sound.

2. In that series where the sound without shock is kept constant there is no great loss in the percentage of responses to sound without shock, even when the effort is made to fatigue the tendency.

3. The loss in the percentage of responses is about the same whether the unfamiliar stimulus differs from the familiar by being less intense or more intense than the familiar.

It has been found that:

1. The theory that loss in percentage of correct responses to sound without shock leads to inattentiveness, and so caused an increase in the reaction time to sound plus shock, and that a rise in the percentage of correct responses to sound without shock makes for more attentiveness to the task at hand and so lowers the reaction time to sound plus shock, is inadequate because it fails to explain why there should be so much greater loss in the percentage of correct response to sound without shock when 39 was substituted for 40 in the 40-39 series.

2. The theory that inattentiveness leads to a disinclination to react to sound plus shock which must be overcome by the shock of the sound plus shock stimulation, and that this disinclination was not overcome when the sound was offered without shock, tends to explain why slow reaction time to sound plus shock (meaning inattentiveness) goes together with loss in the percentage of correct responses to sound without shock; and why fast reaction time(attentiveness) goes together with a rise in the percentage of correct responses to sound without shock. But this theory fails to explain why there should be a greater inattentiveness and a disinclination to react to sound without shock when 39 is substituted for 40 in the 40-39 series.

3. The theory that central fatigue tends to weaken the sound and so not only increases the reaction time to it, but also, being accentuated by the substitution of 39 for 40, tends to decrease the percentage of correct responses to 39 when offered alone, is found, as a result of experiment 2, to be untenable. For in experiment 2, 39 is replaced by 40, a more intense sound. This more intense sound should aid in compensating for the decrease in the intensity of sound 40 thru central fatigue, and so maintain the percentage of correct responses to sound without shock, and, as a result, decrease the reaction time to sound plus shock in the 40-39 series.

It has been found, however, that whether the familiar sound without shock, (in experiment 2. sound 39) is increased or decreased, reaction to it, when offered without shock, is discouraged.

There remains but one further theory, which is that the subject discriminates between 39 and 40 and 39 and 38 somewhat in the following manner. In all of the above experiments, a series of sound plus shock is offered the subject. A certain rhythm of reaction to sound plus shock is developed, and the reaction time does not greatly vary. That it does vary to some extent, is due to the fact that there is no ready signal given the subject. Suddenly a sound without shock is offered. The subject reacts in all probability, but almost immediately becomes aware that shock has been omitted. Here is a new factor, a disturbance. Sound without shock may once more be offered. Again, the reaction rhythm not being as yet greatly broken, the subject reacts, but is further disturbed at the omission of the shock. If sound without shock is again offered, he may ignore it. He may ignore the sound without shock if it is now once more offered. He must now discriminate between sound plus shock and sound without shock. This discrimination takes time and so his reaction time to sound plus increases. This will explain why, in the 40-40 and in the 39-39 series where the intensity of the sound remains constant, reaction time to sound plus shock increases when more and more sounds without shock are introduced in any one column of twenty reactions. In those columns where there are less sounds without shock introduced, the reaction time to sound plus shock lessens, because there is not so much discrimination required.

In the series 40-39, 39-38, 39-40 what is there to be found? As in the series where the sound was kept constant (the 40-40 and the 39-39 series) a procession of sound plus shock is at first offered. A rhythmic reaction and a fairly constant reaction time results. Suddenly sound without shock is interjected. A reaction probably follows,—but a disturbance occurs. For here, as above explained, enters a disturbing element. And so it is found that the reaction time to sound plus shock starts to rise. The rhythmic reaction habit is disturbed and discrimination between sound plus shock and sound without shock enters in. Suddenly at a certain point in the experiment, 39 without shock is substituted for 40 without shock (or, as in experiment 2, 38 and 40 are substituted for 39). What happens? Here, evidently, is a third factor. Not only is there sound of a certain definite intensity plus shock, and sound of the same intensity without shock, but here is suddenly offered a sound without shock which is different from the sound heard before when it was offered with or without shock. The result is a greater disturbance. The

reaction time to the familiar sound and shock rises abruptly. The sound without shock, whether it be the familiar or the new sound is at first reacted to indiscriminately, and then, as the disturbance increases and more discrimination is called for between familiar sound plus shock, familiar sound without shock and the unfamiliar sound without shock, the reaction time to familiar sound plus shock rises greatly. The reaction habit to the familiar sound without shock begins to break down, and soon the subject ignores both the familiar sound without shock and the unfamiliar sound without shock. When he is caught unawares, he reacts to the unfamiliar sound without shock and familiar sound without shock indiscriminately.

Merkel's[1] interesting experiment is to some extent a support of the above contention as to increase in reaction time with the interjection of added disturbing factors. He found that, for one subject, the average reaction time of the right index finger to the appearance on a screen of a definite number was 192 sigma. This was simple reaction time with no discrimination entering in. The experiment was now changed. Discrimination was now to play a part. Each finger of the right hand was given a definite arabic numeral at the appearance of which on the screen it was to react. This one added discrimination factor increased the reaction time for the right index finger to 216 sigma, an increase of 24 sigma over the simple reaction with a definite finger. Once more the experiment was changed by the addition of another discrimination factor. The left hand fingers were given Roman numerals and the reaction to the five Roman numerals was to be with the corresponding finger of the left hand. There began to appear on the screen now the various Roman and Arabic numerals and the subject had react not only with the correct hand but with the correct finger of that hand. There were then two discriminating factors and it was found that the reaction time for the right index finger rose to 273 sigma, an increase of 57 sigma over the one discrimination factor series and an increase of 81 sigma over the non-discrimination or simple reaction time series.

In this way may be explained the greater percentage of loss in the number of correct responses to sound without shock in the 40-39, the 39-38 and the 39-40 series. This would explain, too, the greater increase in these latter series over the series 40-40 and 39-39 of the reaction times to sound plus shock.

[1] Julius Merkel, Die Zeitlichen Verhaltnisse der Willensttatigkeit. Philos. Studien, 2, 1898, 73-127.

To summarize,—

The rhythmic reaction to sound plus shock is broken by the interjection of sound without shock. The reaction time of sound plus shock rises as discrimination becomes necessary.

In the 40-39, the 39-38 and the 39-40 series there is to be found the same rhythmic reaction, which is disturbed by the interjection of the familiar sound without shock. This leads to an increased reaction time to sound plus shock. With the interjection of a new, unfamiliar sound without shock there is greater disturbance, greater need for discrimination, and the reaction time to sound plus shock rises greatly; and the weakly ingrained habit of reacting to sound without shock, becoming now complicated with the addition of a new sound, breaks down.

In this way it may be explained why, in the 40-40 or the 39-39 series, there being only two factors, viz., familiar sound plus shock and familiar sound without shock, there is some disturbance and necessity for discrimination, leading to a concomitant rise in the reaction times to familiar sound plus shock, and some falling off in the number of responses to familiar sound without shock. This will explain, too, why in the 40-39 and the 39-38 and the 39-40 series, there being three factors, viz., familiar sounds plus shock, familiar sound without shock and unfamiliar sound without shock, still greater discrimination is required, the reaction time to the familiar sound plus shock is greatly increased, and very many less sounds without shock are reacted to, and there is no great attempt to discriminate between the familiar sound without shock and the unfamiliar sound without shock, both being reacted to, or ignored.

An Alternative Interpretation:

The training period may be thought of as an attempt to train a subject to react to sound plus shock and to ignore the sound without shock. Since there are no instructions, it would be natural for the subject to adopt this set of alternatives, reaction to sound plus shock and no reaction to sound without shock. A repetition of sound without shock aids in ingraining the habit of ignoring sound when without shock, and so it is found that the repetition of sound without shock causes a loss in the percentage of correct response. This was found to be true in the 40-40 or the 39-39 series. Why is there a

greater loss in the 40-39, the 39-38 and the 39-40 series? In other words, why are more sounds without shock ignored in the latter series? What makes for this better ingraining of the habit of ignoring sound when without shock?

The subject is faced with the task of discriminating between sound plus shock and sound without shock. It is not a difficult discrimination to make, but the subject was given no instructions to make this discrimination. Consequently, the greater the difference between the total stimulus presented in the two cases (sound with and without shock), the greater the likelihood of the differential response taking root. When, therefore, the sound was changed, at the same time that the shock was omitted, the difference in the stimuli thus being greater, the likelihood of a different response was increased. This is easy to see in the experiment reported below where the familiar and the unfamiliar differ supraliminally. The substitution of 39 for 40 gave a slight increase in the difference between the two situations: sound with shock and sound without shock. This slight difference seems to be sufficient to increase the frequency of no reaction to sound alone. Once the reaction begins to be omitted, the differential response is on its way; and even a slight increase in the likelihood of the no-reaction taking place may be sufficient to hasten the fixation of the differential response. The differential response is readily enough established, though it has to combat the existing habit of reacting to the two situations alike. In such a condition of approximate balance between the two tendencies: (1) To react to all stimuli alike, and (2) to adopt the differential response,—even a slight push in the direction of the differential response may give the latter the advantage and serve to fix it.

This habit of no response to sound without shock, would as above explained, lead to inattention and a rise in the reaction time to sound with shock.

It is difficult to choose between these two interpretations. Both are based on the factor of discrimination. Whether the subject discriminates in one way or the other, whether he tries to discriminate between familiar sound plus shock, familiar sound without shock, unfamiliar sound without shock, or whether he tries to discriminate between reaction to sound plus shock and ignore sound without shock, cannot be positively asserted. Both interpretations, therefore, will be upheld in this thesis.

VII. Experiment No. 3

Object:

It was thought advisable at this point to use an unfamiliar secondary stimulus differing from the familiar one by an amount clearly supraliminal.

Subject:

It was felt that H. being thoroughly conditioned to react to 40, would be the best subject to use, and the introduction of the new stimulus 30, should therefore, cause him to manifest very little tendency to react to it as he did to the now thoroughly familiar 40. In that event, it was concluded that he would most quickly of all the subjects learn to differentiate between the two in a manner comparable to the behavior of Watson's subjects.

Instructions:

None required.

Method:

H. was given 325 stimuli of which 83 were sound without shock. As in Watson's experiment, the subject was first given 100 training stimuli of shock plus sound. He responded correctly to each offering of sound without shock whenever presented during the training period and so he was deemed thoroughly conditioned. At the 101st reaction, the new, unfamiliar stimulus 30, was introduced. This was repeated five times. Then ten reactions of shock plus 40 (the familiar stimulus) were given. Then five more 30 without shock were given. Then once more ten of shock plus 40. This procedure was continued for 100 reactions or until reaction 200. At this point, 30 and 40 were introduced indiscriminately to see if H. would react to 40 to which he had been trained to react by accompanying it with punishment, and to see if he would ignore 30 with which he never received punishment and which had been repeated in groups of five times each, in order to discourage any tendency he may have shown to react to it.

Results:

It was found that with the first introduction, of the new unfamiliar stimulus 30, H. failed to react. It was repeated five times and he failed each time to react. (This was perhaps to be expected since the repetition of 30 without shock destroyed any small tendency to react to 30 which may have been present but which did

not manifest itself at the first presentation of 30). Then shock 40 was given and then five more 30 without shock. He ignored the 30 each time. When 40 was now offered without shock he failed to react to it also. After ten punishments, he reacted to 40. 30 was immediately thereafter presented and H. ignored it. It was thought that perhaps H. was beginning to differentiate between 40 and 30. Three more repetitions of 30 without shock were ignored, and then the 40 with shock was again offered but it, too, was ignored. Punishment was once more resorted to and 40 without shock again presented. H. reacted to it, but upon its being offered again, ignored it. Two 30's and another 40 were likewise ignored. Punishment was again applied but from this time onward, in spite of continued repetition of punishment, the tendency to react was lost to both 40 and 30. Graph 9 shows all tendency to react at a zero point.

Series 11.

It was thought best to repeat the series:

Subject:

Same.

Instructions:

Same.

Method:

Same.

Results:

The results are not very different from the series just described. It is to be noticed that H. failed once in the five opportunities to react during the first 100 training reactions. Between column 6-10 there is an increase in the number of correct reactions made but these reactions were indiscriminately to both 30 and 40, when presented without shock. There was no sign of discrimination. Between 10 and 13 H. reacted once in 12 opportunities and this was to 40. The other eleven opportunities of which five were 40, and six were 30, were entirely ignored. The reaction was not again resumed and the level of response is again at zero.

Series 3.

The series is now again repeated but stimulus 40 was retained throughout.

Subject:

Same.

Instructions:

Same.

Method:

Same.

Results:

First to be noticed, is that, although H. failed to react, in both former series, to the first or the first ten presentaions of 30, the presentation of 40 at the same point of this series caused no loss of efficiency and the subject reacted to 40. He continued his reactions to 40 even when it was repeated without shock five times. In spite of repeated effort to fatigue the tendency to react through repetition of 40 in groups of five without shock the level of efficiency remained comparatively high. Effort to fatigue was begun at column five, and the graph shows a fall in the percentage of correct response. But there is a quick recovery and in columns ten and eleven H. is reacting each time to 40 without shock. Column 13 in each series consisted of 24 offerings of sound without shock. In the two series consisting intensity 30, the percentage of correct response is zero. (This is perhaps to be expected, since in these series containing 30, H. had evidenced a loss in the tendency to react to both 40 and 30.) In the last series retaining 40 throughout, of the 24 opportunities offered to react to 40 without shock, thirteen or more than half were responded to.

Two other subjects, C. T. and L. P. were put through the same procedure. The results were almost exactly the same as the results obtained from subject H.

The composite graph shows results of the three subjects. The difference in P. E. units for columns 2-5, the training period, is .98. This is too small a difference to warrant the assertion that the difference between the two series for each subject for columns 5-13 is due to the difference between the two training periods in the two series for each subject.

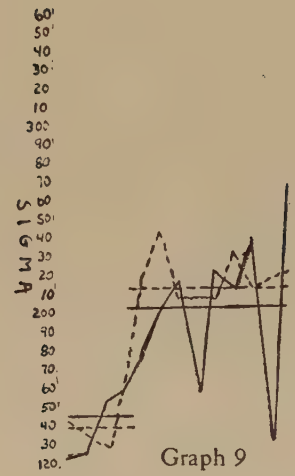
The following table gives for each series for columns 5 to 13 the average percentages of correct responses to sound without shock, the P. E. of the difference between the series and that difference expressed in P. E. units.

Subject	Averages		P.E. Diff.	Difference in P.E. Units
	40-40	40-30		
Trow	79.5 ± 8.9	34 ± 16.8	19.1	2.38
L. P.	89.6 ± 3.9	33 ± 6.8	7.88	7.05
Holmes	86.6 ± 3.	31 ± 7.2	7.8	7.5
Composite	85.2 ± 13.8	32.8 ± 10.2	11.59	5.49

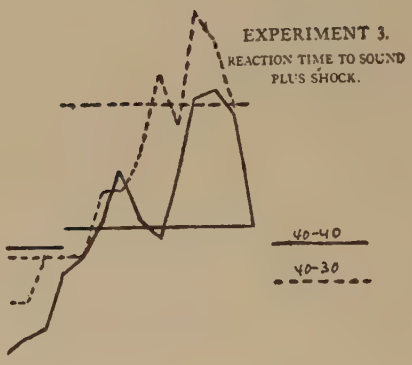
Correlations Between Correct Response and Reaction Time

The graphs for reaction time (graphs 9, 10 and 11, tables 19 to 23) to sound plus shock show, as in the previous experiments, the same approximate accompanying variation in reaction time with the variation in the percentage of correct response to sound alone.

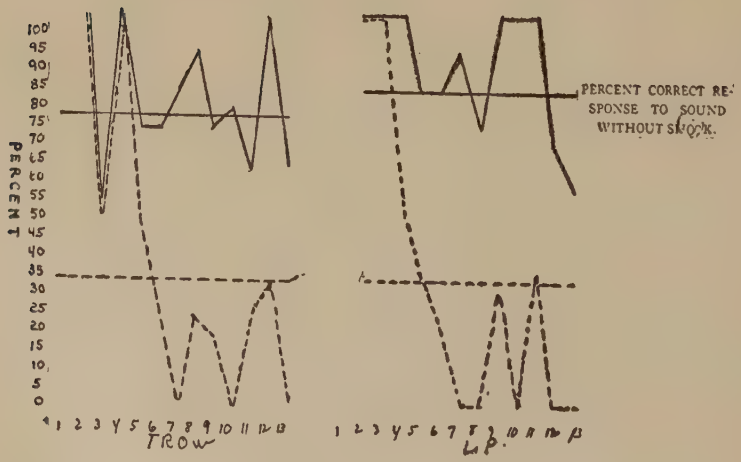
An attempt (table 24 and 25) was made as in the previous experiments to find the correlation between the rise and fall in the percentage of correct responses to sound without shock and the rise and fall in the reaction time averages for the reactions to sound with shock for the critical columns 5 to 12. Due without doubt to the arbitrary method of dividing the record sheets into columns, the correlations seem to be, in nearly every case, quite the opposite from those obtained in the previous experiments. In almost every case as seen on the graphs the change in the reaction time to sound plus shock did not immediately show up, but made itself noticeable a column after the presentation of a group of sounds without shock.



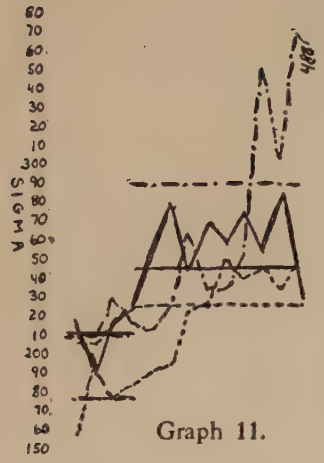
Graph 9



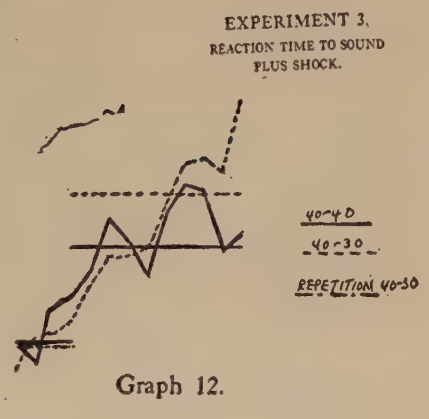
Graph 10.



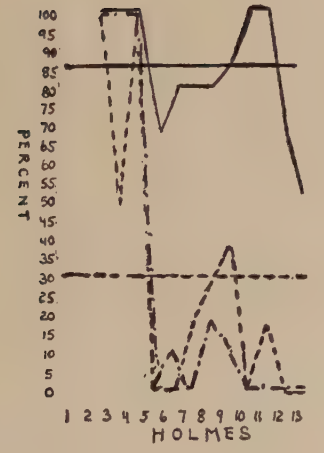
Experiment 3—Graphs 11 and 12



Graph 11.



Graph 12.



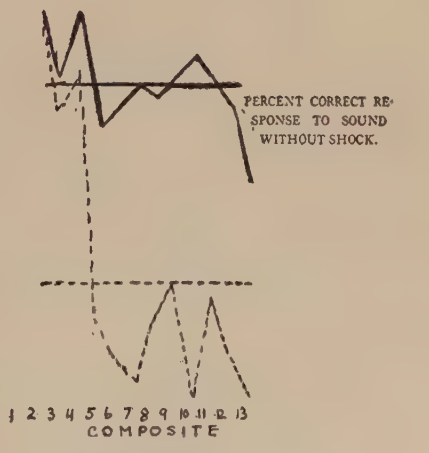


Table 19

Table showing by columns the number of sounds with shock, the number of sounds without shock, the number of sounds without shock reacted to, the percentage of responses to sound without shock and the reactions time to sound with shock.

Series 40-40

Subject	No. Sounds With Shock	No. Sounds Without Shock	No. Sounds Without Shock Reacted to	Percent Response to Sound Without Shock	Average Reaction Time to Sound With Shock	Column on Record Sheet
L. P.....	25	..	..	..	173.3	1
	24	1	1	100	178.95	2
	23	2	2	100	214.45	3
	23	2	2	100	220	4
	15	10	8	80	236.8	5
	15	10	8	80	266.5	6
	20	5	4	90	238	7
	15	10	7	70	227.8	8
	18	7	7	100	264	9
	21	4	4	100	300.75	10
	20	5	5	100	301.75	11
	22	3	2	66	290	12
	1	24	14	58	232.5	13
Trow	25	..	..	..	124.9	1
	24	1	1	100	126	2
	23	2	2	50	153	3
	23	2	2	100	160.65	4
	15	10	8	70	175	5
	15	10	8	70	201	6
	20	5	4	80	219.85	7
	15	10	7	90	148	8
	18	7	7	71	224.7	9
	21	4	4	75	216	10
	20	5	5	60	239	11
	22	3	2	100	133	12
	1	24	14	62.5	260	13

Series 40-40

Table 20

Table showing by columns the number of sounds with shock, the number of sounds without shock, the number of sounds without shock reacted to, the percentage of responses to sound without shock and the reaction time to sound with shock.

Series 40-40

Subject	No. Sounds With Shock	No. Sounds Without Shock	No. Sounds Without Shock Reacted to	Percent Response to Sound Without Shock	Average Reaction Time to Sound With Shock	Column on Record Sheet
Holmes ..	25	..	..	..	218	1
	24	1	1	100	187.5	2
	23	2	2	100	216	3
	23	2	2	100	226	4
	15	10	7	70	247	5
	15	10	8	80	277	6
	20	5	4	80	239	7
	15	10	8	80	268	8
	18	7	6	85	258	9
	21	4	4	100	273	10
	20	5	5	100	247	11
	22	3	2	66	280	12
	1	24	13	52	225	13
Composite three subjects	25	..	..	...	172	1
	24	1	1	100	164	2
	23	2	2	83	194	3
	23	2	2	100	202	4
	15	10	7.66	73	219	5
	15	10	8	76	246	6
	20	5	4	83	232	7
	15	10	7.3	80	214	8
	18	7	6.6	85	249	9
	21	4	4	91.6	263	10
	20	5	5	86.6	262	11
	22	3	2	77	234	12
	1	24	13.6	57.5	239	13

Table 21

Table showing by columns the number of sounds with shock, the number of sounds without shock, the number of sounds without shock reacted to, the percentage of reaction to sound without shock and the reaction time to sound with shock.

Series 40-30

Subject	No. Sounds With Shock	No. Sounds Without Shock			No. Sounds Without Shock Reacted to			Percent Response to Sound Without Shock	Average Reaction Time to Sound With Shock	Column on Record Sheet
		40	30	T	40	30	T			
L. P.	25	.	.	.	.	.	.	...	164	1
	24	1	.	1	1	.	1	100	198	2
	23	2	.	2	2	.	2	100	214	3
	23	2	.	2	1	.	1	50	214.6	4
	15	.	10	10	.	3	3	30	215	5
	15	.	10	10	.	2	2	20	252	6
	20	.	5	5	.	.	.	...	252.5	7
	15	4	6	10	.	.	.	...	275	8
	18	4	3	7	1	1	2	28	309.7	9
	21	2	2	4	.	.	.	...	282.5	10
	20	2	3	5	1	1	2	40	352.5	11
	22	2	1	3	.	.	.	...	331.9	12
	1	13	11	24	.	.	.	...	297.5	13
Trow	25	.	.	.	.	.	.	...	138.8	1
	24	1	.	1	1	.	1	100	128.7	2
	23	2	.	2	1	.	1	50	125.9	3
	23	2	.	2	2	.	2	100	156.7	4
	15	.	10	10	.	5	5	50	217	5
	15	1	10	10	.	.	.	...	240.8	6
	20	.	5	5	.	.	.	...	205.7	7
	15	4	6	10	1	1	2	20	205.5	8
	18	4	3	7	1	.	1	14	205.8	9
	21	2	2	4	.	.	.	...	230	10
	20	2	3	5	.	1	1	20	211	11
	22	2	1	3	1	.	1	33	214	12
	1	13	11	24	.	.	.	...	215	13

Series 40-30

Table 22

Table showing by columns the number of sounds with shock, the number of sounds without shock, the number of sounds without shock reacted to, the percentage of reaction to sound without shock and the reaction time to sound with shock.

Series 40-30

Subject	No. Sounds With Shock	No. Sounds Without Shock			No. Sounds Without Shock Reacted to			Percent Response to Sound Without Shock	Average Reaction Time to Sound With Shock	Column on Record Sheet
		40	30	T	40	30	T			
Holmes ..	25	.	.	.	.	.	.	...	159	1
	24	1	.	1	1	.	1	100	188.8	2
	23	2	.	2	2	.	2	100	171.8	3
	23	2	.	2	2	.	2	100	182.4	4
	15	.	10	10	.	.	.	...	186.9	5
	15	.	10	10	.	1	1	10	189	6
	20	.	5	5	.	.	.	...	222	7
	15	4	6	10	1	1	2	20	221.6	8
	18	4	3	7	1	.	1	14	249.7	9
	21	2	3	4	.	.	.	...	235.8	10
	20	2	3	5	.	.	.	...	239.8	11
	22	2	1	3	.	.	.	...	231	12
	1	13	11	24	.	.	.	...	245	13
Holmes repetition of above 40-30 ...	25	.	.	.	.	.	.	...	204.6	1
	24	1	.	1	1	.	1	100	203.5	2
	23	2	.	2	1	.	1	50	224.5	3
	23	2	.	2	2	.	2	100	214.9	4
	15	.	10	10	.	.	.	...	220.8	5
	15	.	10	10	.	.	.	...	260.5	6
	20	.	5	5	.	1	1	20	224	7
	15	4	6	10	2	1	3	30	249	8
	18	4	3	7	1	2	3	40	351	9
	20	2	2	4	.	.	.	...	300	10
	21	2	3	5	1	.	1	20	305	11
	22	2	1	3	.	.	.	...	312	12
	1	13	11	24	.	.	.	...	480	13

Table 23

Table showing by columns the number of sounds with shock, the number of sounds without shock, the number of sounds without shock reacted to, the percentage of reaction to sound without shock and the reaction time to sound with shock.

Series 40-30

Subject	No. Sounds With Shock	No. Sounds Without Shock			No. Sounds Without Shock Reacted to			Percent Response to Sound Without Shock	Reaction Time to Sound With Shock	Column on Record Sheet
		40	30	T	40	30	T			
Composite three subjects	25	.	.	.	..	..	..	.....	166.7	1
	24	1	.	1	1	..	1	100	180	2
	23	2	.	2	1.5	..	1.5	75	184	3
	23	2	.	2	1.7	..	1.7	87	191.7	4
	15	.	10	10	..	2	2	20	210	5
	15	.	10	10	..	.75	.75	7.5	223	6
	21	.	5	5	..	.25	.25	5	226	7
	15	4	6	10	1	.75	1.75	17.5	232	8
	18	4	3	7	1	.75	1.75	24	253.5	9
	21	2	2	4	..	..	..	.....	274.7	10
	20	2	3	5	.5	.5	1	20	275.7	11
	22	2	1	3	.2	..	.25	8.2	270	12
	1	13	11	24	..	..	..	.....	311	13

Table 24

Correlations for columns 5-13 in the series 40-40 between reaction time to sound with shock and percentage of correct response to sound without shock.

Subject	Correlation	P.E.
L. P.	.6	.14
Trow	—.716	.1
Holmes	.736	.1
Composite	.62	.1

Table 25

Comparison for columns 5-13, in series 40-30, between reaction time to sound with shock and per cent correct responses for sound without shock for those columns whose percentages are from 0-29 and those whose percentages are from 30-100.

Subject	Av. reaction time for those columns whose per cent correct response is from 0-29.	Av. reaction time for those columns whose per cent correct response is from 30-100.	Difference
L. P.	285.8	283.7	2.1
Trow	216.2	215	1.2
Holmes 1, 2	226 301	No scores. 300	1
Composite	257.7	266.2	8.5

Conclusions:

1. The repetition of the secondary stimulus without shock causes a loss in the percentage of correct responses to sound without shock.

2. This loss is greatest where an unfamiliar sound is substituted for the familiar one.

3. This greater loss is due to the greater discrimination required in the series where an unfamiliar sound was introduced, this greater discrimination causing a breakdown in the reaction habit to the familiar sound without shock; or

4. This greater loss is due to the fact that the unfamiliar sound directly aided in fixing the habit of reacting to sound plus shock and the ignoring of sound without shock.

5. The greater discrimination led to a greater increase in the reaction time to familiar sound plus shock in the series wherein was introduced an unfamiliar sound than in the series where the familiar sound was retained throughout; or

6. The ingraining of the habit of reacting to sound plus shock and ignoring of the sound when alone caused periods of no reaction. These idle periods caused inattention and for this reason a rise in the reaction time to sound plus shock.

VIII. General Conclusions

1. Human beings show evidence of being able to discriminate between two sounds that differ "subliminally."

2. A subject trained to react to a sound of a certain definite intensity will lose that reaction habit if an unfamiliar sound, differing from the familiar one subliminally or supraliminally, is substituted for the familiar one.

3. This loss is due to difficulty in discriminating between the three factors, familiar sound with shock, familiar sound without shock and unfamiliar sound without shock; or

4. This loss is due to the direct aid given by the unfamiliar stimulus in inculcating the habit of reacting to sound plus shock and ignoring sound without shock.

5. Discrimination causes an increase in the reaction time to the familiar sound plus shock; or

6. The ingraining of the habit to ignore sound when alone causes periods of idleness and concomitant inattention, leading to an increase in the reaction time to sound with shock.

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